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October 4, 1928

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REGIONAL ENGINEERING—*An Introduction, by W. W. De Berard*

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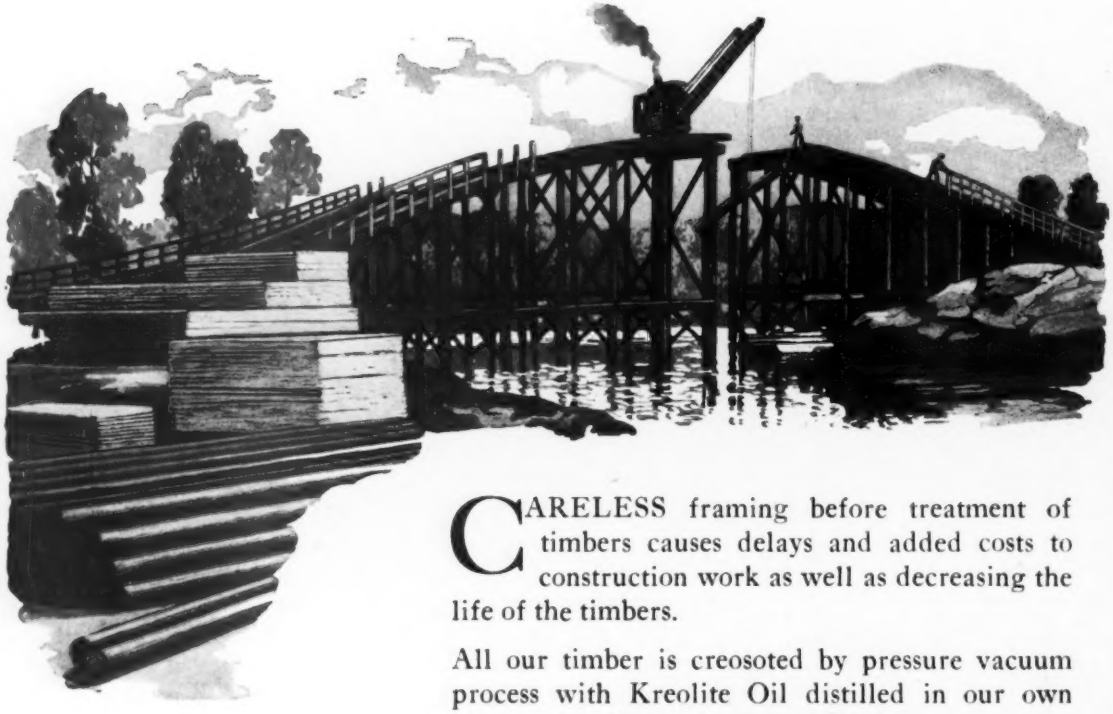

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Contents

Volume 101, Number 14, October 4, 1928

Regional Engineering, Its Problems, Status and Future Requirements 496

IN THIS, an opening discussion of a new problem, the author discusses the trend of metropolitanism, which confronts engineers with new difficulties and opens a new field of activity. By W. W. De Berard

Gate Tower, Tilted by Ice, Returns to Position 502

ICE SHEET causes cracks in base of concrete intake tower at Magic dam, Idaho. By George N. Carter

Reducing Fire Hazards During Construction 503

METHODS of reducing dollars lost by the neglect of simple precautions are discussed. By O. J. Swander

Algæ Control by Creating Turbidity 505

NOVEL METHOD used in Louisville, Ky., to solve one of the problems in water-filtration plants. By W. H. Lovejoy

Shrinkage Effect of Celite in Mortar and Concrete 507

TESTS SHOW that 1:3 mortar with 2 per cent admixture shrinks 10 to 25 per cent; concrete shrinks less. By A. S. Levens

Building a 375-Mile Pipe Line in 193 Calendar Days 509

RECORD SPEED made in laying natural gas line from Texas Panhandle to Denver. By Wm. Thompson Smith

Florida Damage Confined to Poorly Built Structures 515

SURVEY of conditions at the Palm Beaches shows slight damage to well-constructed buildings. By R. S. Tilden

Traffic Problems

NEXT week will be published an article on the control of street traffic at

San Francisco

IT IS to be followed by other articles dealing with similar problems in other cities.

THE subject is of wide interest, especially the steps which are being taken to put accepted theories into practice.

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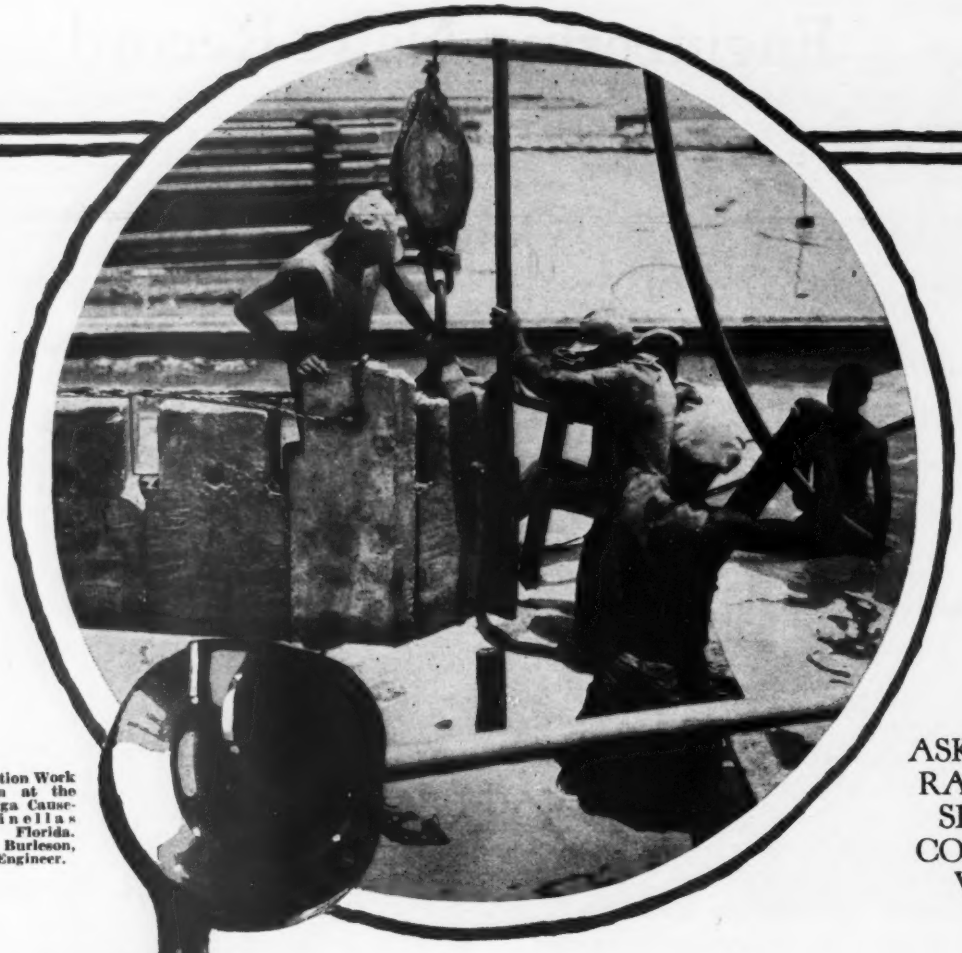

Construction Work going on at the Boca Ceiga Causeway, Pinellas County, Florida. C. E. Burleson, County Engineer.

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Volume 101 NEW YORK, OCTOBER 4, 1928 Number 14

Preventable Damage

A CAREFUL study of storm effects at Palm Beach and West Palm Beach but emphasizes earlier conclusions as to the character of the structures damaged. Well-built buildings were not seriously affected. The great damage was to poorly or lightly built ones. It seems clear, then, that we need not despair of ever being able to put up structures which will stand before such storms as swept across Florida and many islands in the West Indies last month. A thorough examination of the damaged structures will show what types of construction stand up well and what types are an easy prey to high winds. By eliminating the latter and specifying the former it should be possible to build structures which will survive without undue damage storms of intensity as great as any so far recorded.

Is the Lesson to Be Lost?

AN EXCELLENT picture of the character of the damage done to buildings in Palm Beach and West Palm Beach by the hurricane is given in the report by R. S. Tilden printed elsewhere in this issue. The inescapable conclusion upon reading his report is that the two cities had either inadequate building codes or codes which were not properly enforced. The only explanation lies in the fact that most of the damaged buildings were put up in the boom days and before the Miami storm of two years ago had shown what a tropical hurricane may do. The worst feature of the present situation, however, is that there appears to be an inclination upon the part of some of the city authorities to look upon the coming reconstruction work as of an emergency character and therefore not subject to strict control by building regulation. Add to this the fact that post-boom economies have seriously reduced the number of building inspectors available and one is forced to conclude that Palm Beach and West Palm Beach are not likely to profit to the fullest extent from the lessons learned in this calamity.

Fighting Trouble With Trouble

RESOURCEFUL men having met and conquered one trouble and being confronted with another sometimes have recourse to the first to control the second. An example of the kind, one of literally stirring up trouble after it has been settled, is afforded by the novel means of combating algal growths in the water supply of Louisville, Ky., described in this issue. All previously known and some new methods of algæ control having either failed or else created new troubles, a hint from Mother Nature was followed with abundant success. The algæ causing no trouble in the water when the river turbidity was high and being rampant when it was low, artificial turbidity was created in the settling reservoir. By this means the algæ were kept down, the filter runs between washings increased; and consequently there was a remarkable decrease in the filtered water used for washing the filters and also in the time the filters were out of use for washing. At the same time the bacteria in the settled water, instead of increasing, as might be expected, declined. Although the very simple means used to create artificial turbidity at Louisville—using the dredge pump to stir up instead of to remove sediment—would not be available at some plants, some other efficacious methods to the same end could doubtless be devised by equally competent water-works operators. The lesson from Louisville lies in the last-named fact or assumption, rather than in the particular method employed at Louisville, which might or might not be usable elsewhere. The function of the engineer, as was so well expressed a century ago, is to utilize the forces of nature for the benefit of man. To do this, he may have to create trouble, or what would be such under other conditions. Constantly he sets one force at work against another—at Louisville, turbidity against algæ. With the advance of engineering and biochemistry the available forces, or at least ways and means of using them, are constantly increasing. Wise is the city or the industry that has the sense and the will to employ men with technical training, experience and resourcefulness to utilize these forces, even to setting one trouble to combat and quell another.

Fall Business

PROSPECTS for business during the last quarter of the year reveal few rough spots, according to reports from nearly every branch of industrial activity. Business should be good. Probably it will continue its high plane, largely unchecked since the first of the year, when it recovered from the comparatively slow last half of 1927. Engineering construction continues as a major factor in the country's general business. It has a good back-log of contracts awarded which should maintain undiminished its present activity. And since it has registered to date a gain in contracts awarded of 15 per cent over the first nine months of 1927, the year should end with a substantial increase in construction volume to its credit. On the other hand, any long-time prediction is tempered by the present irregular and rising money rates. As was to be expected, these have already had their effect on speculative building, which has declined slightly. To say that industrial and public works would not be similarly affected should capital costs remain high for a long period would be to disregard precedent; but that they will have little effect on the construction activity of the remainder of this year seems certain.

Men or Machines

IN ALL of the larger cities the use of mechanical tools for snow removal—loaders and clamshell buckets—increases annually. At the same time hand shoveling of snow is done by a large army of workmen otherwise unemployed in winter, and often the contention is advanced that these men's jobs will be destroyed and they

be thrown upon the charity departments of the cities because of the use of mechanical snow-loading methods. There may be some point to the argument, but it is not new, nor is it hard to refute. It has been urged again and again, ever since machines began to supplant hand labor. Experience shows that machines increase employment and provide means for the purchase of more goods for the employed. The economics of mechanical snow loading is simple. In the business districts, speed in clearing the snow is a first requisite. Here, without doubt, is a field for a machine; hand labor is too slow. But there are miles of important streets in industrial and residential sections that suffer from improper snow removal. Men displaced in the business districts can be put at work in those sections, thus extending the street mileage cleared of snow and the people and property benefited. The obvious method, therefore, is to mechanize completely the work of snow loading in the business districts and use the hand laborers in outlying districts—that is, if it be assumed that chance jobs at snow removal is much of a factor in providing work for the unemployed and that true municipal economy does not call for the use of machines wherever snow is to be removed from the streets. At the best, snow removal is an uncertain way of caring for those out of work and, in so far as it engages the temporary services of office and factory men unused to hard labor and to exposure.

Progress by Organized Contracting

WITH the adjournment of its fall meeting last Wednesday at Minneapolis, the Associated General Contractors finished the last work in general assembly of the first decade of its life. When the members next meet, in annual convention at Chicago on Feb. 18, 1929, the association will have entered its eleventh year. What has it done since the first organization meeting in November, 1918? What, to go back to a date six months earlier, has grown out of that little gathering in Atlantic City to talk organization, of half a dozen men harassed by the necessity of dealing as individuals with a government emerging from war when all other businesses were bringing to bear the power of concerted action in forwarding their interests and in defending their rights? The questions are worth thought at this time.

There have been many accomplishments in detail. A trained working staff has been created. An income has been assured which provides for a budgeted expenditure of $100,000 to $150,000 a year. More than a hundred branches and chapters have been chartered and are operating actively in all parts of the country. There has been work done in developing uniform contracts, in surety bonding reform, in drafting a uniform lien law, in combating day labor, in accident prevention, in battling false credit practices, in prequalifying contractors, in establishing quantity surveying and in a score of other activities. None of these is the outstanding accomplishment. The great thing that has been truly done is to create a recognized and a respected working force in the engineering construction industry. Whatever else of association accomplishment may be disputed, this has to be admitted.

Through the Associated General Contractors the contracting business has become an organized force whose influence is felt and whose aid is sought in many activities. At the Minneapolis meeting it was made known that the organization staff was regularly or occasionally co-operating with more than 75 national business and technical associations and government bureaus. The association vote of 2,500 members doing 75 per cent of the construction of the United States counts heavily and is sought in every action that affects the industry. The attainment has brought responsibilities. The greatest of these is to set the association's own affairs straight. This duty the association well recognizes. But there is more.

Today the Associated General Contractors requires a new organization plan and a new set-up of authority and rules for carrying out this plan, if it is to meet fully its association opportunities. At the Minneapolis meeting last week the new plan was given tentative membership approval. The management of the A.G.C. was granted power to submit a change in its bylaws which will permit association with it of allied industries. The equipment manufacturers, their distributors, the materials producers, the subcontracting trades, the surety bonding and liability insurance interests are all sought in this lineup.

As the buyers of the services rendered by all these construction agencies, the contractors consider that their association, with its established prestige, is the one organization that can co-ordinate these affiliated bodies and govern their joint activities. The proposed plan opens many roads for thought which cannot here be followed through.

The important fact at the present moment is that organized contracting comes to its second decade of active life with a broad constructive plan of development. It is a practical and a practicable plan. Affiliation has already begun. Where it has been begun it has endured and gained strength. The idea is not visionary. It is not contemplated that organized co-ordination of the construction industry is to be quickly accomplished or accomplished without revision of plans and estimates. The definite plan of action will be passed on at the coming annual convention in Chicago. It deserves the best preliminary thought that can be brought to it by the leaders in construction.

Basic Highway Data

MANY millions are being appropriated and spent for road work on the basis of popular impressions in place of definite knowledge of traffic needs. With the experience which has been developed in conducting half a score of state-wide traffic surveys it is a derelict citizenry, be it county or state, that will let newspapers and motor clubs determine its roadbuilding program wthout benefit of engineering analysis of present and expected traffic volume—its kind, distribution, destination and concentration. The doctrine of the good roads propagandist that "all roads are good roads to pave" has about reached the limit of whatever usefulness it ever had. It is time that our official roadbuilding agencies should be given the power and the means to accumulate precise information on traffic as the basis for highway improvement programs.

Several states, notably Wisconsin, Pennsylvania, New York, California, Maryland and Minnesota, have traffic-count records extending over a number of years. In the region of New York the latest traffic counts were made in 1922, and in the region of Chicago in 1924. These figures give one point on the curve of increased or decreased use from year to year. Every newly paved or widened highway causes a shift in traffic. If every road were paved one might determine with accuracy where

traffic wanted to go and for what volume to provide, but in a developing system, whose capacity is overloaded at some points and wofully underused in others, all questions of location, width and type are engineering matters of serious kind, that can be dealt with only on the basis of fact. Incidentally, no field is more fertile for the landowning politician, his friends and his syndicate than that of road locations, and the temptation to decide on political grounds has therefore always been strong.

What is to be done? The roads are needed to relieve traffic, and a program must be made. The engineer, if called in, is more than likely given too little time to do more than cruise over the area on existing roads and look over traffic statistics that are many years old. The program cannot or will not wait on the engineer, and he has neither funds nor staff to get the fundamental data of traffic on which to build a program. Newspapers and motor clubs formulate ideas based on Sunday afternoon congestion; "We want better and wider highways everywhere," they honk. Amateur highway enthusiasts propose three- to six-level streets. Others propose grade separation at every highway intersection.

A Chicago newspaper proposes pavements 40 ft. wide, out to a distance of 100 miles from the metropolitan center, and two opposing candidates for governor indorsed the idea, though they say nothing in favor of the gas tax—the only practical means of payment. Will the newspaper and the motor club interests which back its idea about-face on the gas tax? "Nothing less than 40 ft. wide anywhere," is the cry of others. And again, some propose 36 ft. of pavement for four lanes of traffic; others a minimum of 40 ft.; while still others want an odd number of lanes for moving traffic, such as 30 ft. and 48 or 50 ft.

Most of the officials of the U. S. Bureau of Public Roads and of the states and counties are doing the best they can under programs laid down by the legislators or controlled in some measure by political expediency. They are under no illusions as to the inadequacy of the plans they are carrying out. They want to serve the traffic needs but are greatly hampered for lack of facts.

In view of this tangled situation, the establishment of some agency to make traffic counts on a comprehensive basis in metropolitan areas would seem to be the first step toward bringing order out of chaos. The time has come, especially in the region of metropolitan centers, when pavement programs and right-of-way acquisitions must be based upon scientific information rather than opinion and guess. Pavement and right-of-way planning in the Chicago region is still based on the 1924 survey supplemented by meager traffic counts on a few arteries, and whatever interpolations or extrapolations were necessary have been based on the assumption of continuous growth, disregarding facts and the possible effect of newly opened diversions. It is time to get basic information.

Just how much traffic is there in the outlying districts? What are its characteristics? Answers to such questions will be of as much value in operation as has been the case in handling traffic in the central business districts. What is of still more importance, however, such information will enable the engineers to draw up a real engineering program, closely fitted to future necessities.

Some 40-ft. country roads will then be found feasible, but many more may never be needed, or not until their areas have been built up far more than at present. Certain railroad grade crossings will be found unnecessary and will be closed; those that should be left can then be separated, financed and built. Highway grade separations at certain points may be found of far more value to traffic than separations of grades at many railroad crossings. In short, a sound and long-term program becomes feasible when basic data are available, *and only then*. The co-operation of the federal, state and county agencies could and should bring about collection of such information. Will they do it?

Coming Transformations

IN THESE days change is more familiar, more rapid and continuous than it was in the world's younger years, and things that once seemed stable undergo transformation almost unnoticed. The railroad era was well upon us before men began to understand that it had introduced a social and economic revolution. Similar lag of comprehension exists today. What the motor vehicle, the radio and the airplane will accomplish in changing human habits and ways is still largely unsuspected, but doubtless we are on the threshold of changes even more profound than those which followed the creation of the iron way. Be it noted that even yet the results of the universalization of telephone interconnection and the placing of electric power in every nook and corner of the country have not fully revealed themselves; our activities are still in the process of changing under their influence.

One result of modern technical developments that is already apparent—though only in its earliest forms, no doubt—is their dispersive effect on cities. Far-spreading networks of communities and population-strings are evolving round about the cities; they have common interests and closely interdependent physical needs, and therefore have a certain unity from both engineering and administrative viewpoints. But they present many serious new problems to the engineer as well as to the legislator and the administrator, and in all likelihood will give rise to still further problems as regional growth increases and becomes more fully defined.

Because men of many kinds are concerned with regional growth, an introductory sketch of the new aspects of these communities is given in this issue. Several other articles are to follow. Their major purpose is twofold: first, to direct the attention of engineers to certain matters which within a short time they will be required to handle (and this refers to municipal, utility, transportation and sanitary engineers, perhaps also others); second, to demonstrate that the administrative or political phase of the regional problem is central to the whole case and that engineering thought should in this case be extended to include politics or government as well as pure technology.

It is even more important to bear in mind that the urban region has only begun to take shape and that its problems lie mainly in the future. Nothing in the way of definite forecast is yet possible. What may be learned from those places where regional engineering problems have become pressing is likely to be of value and have application everywhere. Already it is clear that the problems are of such character that long-time advance planning is profitable. The problems are sure to increase in number and gravity and to change in their nature as the development proceeds. The subject, therefore, invites many-sided study. It claims the interest of every branch of the civil engineering profession.

Regional Engineering, Its Problems, Status and Future Requirements

An Opening Discussion of a New Problem

The Inevitable Trend of Metropolitanism Confronts Engineers With New Difficulties and Opens a New Field of Activity—Co-operative Methods of Securing Community Service Require New Methods of Attack—Some Things That Are Being Done in This Field

By W. W. De Berard

Associate Editor, Engineering News-Record, Chicago, and Sometime Chief Engineer of the Chicago Regional Planning Association

Strung Like Beads on a string, the early towns in the neighborhood of our large cities were located at short intervals along the railroad lines radiating from the center. These beads have grown by accretion in the course of time. Additional means and routes of transportation have developed new towns and modified the old ones. Thus the shortening of travel time which is responsible for the skyscraper has also brought about the far-flung expansion of the metropolitan *region*. The ingenuity of the engineer, which has made possible all three, is now called upon to lighten the resulting burdens: to speed up transportation, to furnish the facilities by which concentrated masses of men can exist and produce in skyscraper surroundings and to provide the farthest habitation of the satellite town in the metropolitan regional community with all the facilities of modern civilization. Heretofore the first two of these problems have monopolized attention. The efforts of municipal engineers were focused almost exclusively on the central core of metropolitan life and transport. But current developments are rapidly bringing the regional community problem into the forefront of interest. It is proposed therefore to present a series of articles outlining the nature and conditions of metropolitan regions and sketching the methods of solution of their problems, in typical regional communities clustering around great centers of population. —Editor.

ALMOST over night regional engineering has become a country-wide necessity. It has existed in specific single applications for many decades. Very recent years, however, have suddenly crystallized the problems involved into a coherent engineering field of study.

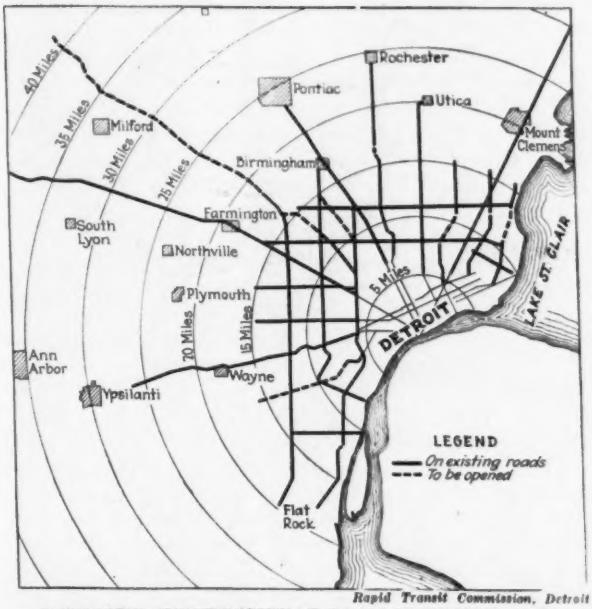
Putting the public on wheels ten to fifteen years ago followed the great strides in sanitation a decade or two earlier. Sanitation unconsciously fostered decentralization; the motor car accelerated it tremendously. Now, through the continuing effect of these agencies, cities and their suburbs are growing together. Suburban areas are broadening, and even more remote cities and towns are coming near to the metropolis in travel time and in interests. True regional communities are evolving, far greater than any city, often embracing scores of towns.

What does this development of the regional area mean? The mass of citizens is as yet hardly conscious of more than a vague feeling of inadequate facilities now in one, now in another class of service. The engineer

© Chicago Aerial Survey Co

SUBURBS ADJOINING THE GREAT CENTERS MERGE INTO ONE ANOTHER, MAKING BUILT-UP AREAS CONTINUOUS

Looking east over Elmwood Park, with Chicago in the distance and Oak Park to the south. Westwood, the new suburban development with the peculiar circular layout, lies to the left of Grand Ave., which is destined to be one of the principal arteries into Chicago from the west. Note the jogs and dead ends, leaving few through streets possible.



Rapid Transit Commission, Detroit

DETROIT'S SUPERHIGHWAY PLAN IS DESIGNED TO AFFORD THE MAXIMUM FLUIDITY OF TRAFFIC

realizes more concretely the need for extending various services beyond the limits of a city and its suburbs, to cover a whole region. Engineering problems of broad scope present themselves.

But these problems, while greater and more complicated than those which have already been met and solved, are new only in size and in respect to mutual interrelation. They can be solved, we know. We see that the greatest obstacle is the lack of governmental machinery. Human nature, local civic pride and politics being what they are, there are vast forces and inertias opposing every attempt to bring about the joint attack on the engineering problems without which these cannot be solved.

Nature and Evolution of the Region—Rapidly growing cities are constantly throwing out suburban fringes, extending farther and farther from their centers. At the same time they become surrounded with satellite cities, each with its own distinctive features. Suburb and satellite have their own individual civic pride in their achievements. Their political personnel is more dominated by local sentiment (for good or bad) than would be that of the central city in case of annexation. In consequence annexation becomes harder and harder. But growth continues regardless of political boundaries.

Usually residences form the outskirts of a large city. In the city of half a million people and more, however, factories also move out. As the region prospers and industrial development increases, a spreading out of the population thus inevitably occurs. While central locations for industry are desirable, such factors as competition and mounting costs of rentals entailed by the more intensive use of the land near the center of population force industry to the outskirts or to a less expensive location in a satellite town.

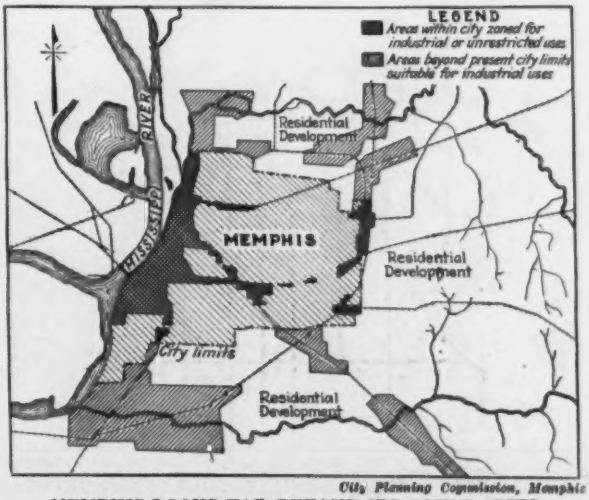
So far as the engineer is concerned, this centrifugal movement carries with it the necessity of providing in the outer areas all the services which already exist at the center, as well as connecting the services of the central district with those in the outlying region and the latter with each other. There results a pressing need for revision and interconnection of the transport, water-supply, sewerage, drainage and other utility facilities.

If some of these elements be considered separately, the characteristics of the regional-community problem will appear more clearly.

Transport—Railroads, street railways, highways and streets must be connected circumferentially as well as radially if the region is to have adequate transport service. Also—a problem quite new—airports need planning in connection with existing and proposed vehicular and rail routes. In one sense at least, transport needs form the heart of the regional problem.

The motorist (and everybody is one these days) wants a smooth and wide pavement between towns. He wants it to carry him direct to a maximum of destinations. Realtors, until recently knowing nothing and caring less about town planning, carried out their separate developments without regard for any central scheme. They have left us with a hodge-podge of street layouts, marked by dead ends, jogs, narrow widths, poor pavements and a total lack of co-ordination with the contiguous areas. The few wide trunk roads and boulevards that do exist are so crowded and choked with traffic that traffic relief becomes one of the greatest of municipal problems of the day. Often the most serious difficulty is in a stretch at the outskirts of the city, due to poor alignment or to local indifference to the needs of through traffic coupled with financial inability to meet the high cost of a sufficiently wide road. Most naturally, then, the motorist becomes one of the forces leading to demands for regional-engineering work.

Air transport was mentioned a moment ago as a new factor. Its far-flung accessories of landing fields, flood-lighting, signaling, drainage and connecting roads are beginning to make insistent demands on cities for service beyond the limits of the municipality. A field to receive mail and passengers is of little use without a direct, good road to the center. This road may pass half a dozen suburbs before it reaches the main post office or the railway station, business or hotel district. Drainage of the field must go somewhere, perhaps across a town. Water, gas, electricity, telephone and police protection all must be furnished, and if the field is municipally owned but lies without the confines of the owner city, complications of many kinds arise. Only co-ordinated planning can solve these effectively. The speedier the means of transport the more difficult and greater the need for regional thinking.



City Planning Commission, Memphis

MEMPHIS LOOKS FAR BEYOND ITS BOUNDARIES FOR FUTURE INDUSTRIAL SITES

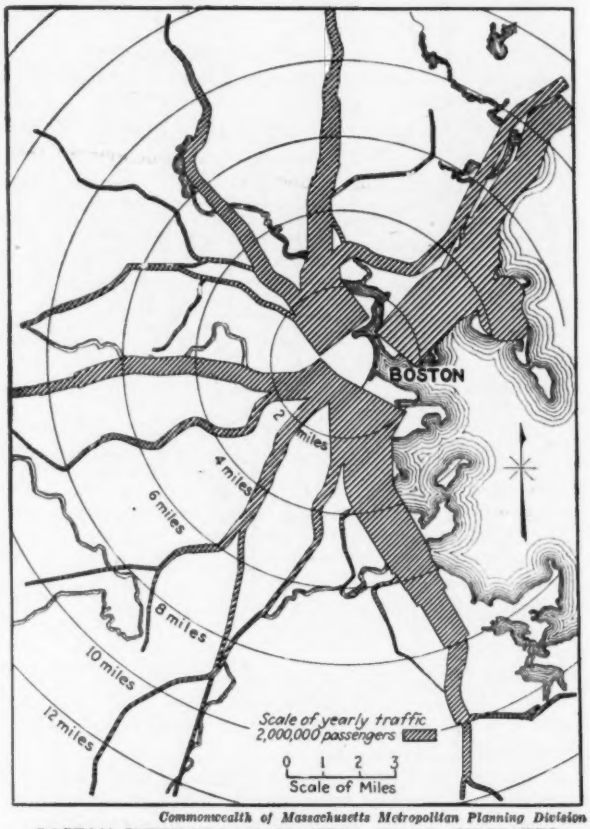
Water and Sewerage—Water-supply and sewerage facilities are fundamental to modern civilized existence. They necessitate skillful planning to anticipate demands.

The water consumer did not move to the suburbs for a poor quality of water, low pressure or high price. The engineer can hardly satisfy the requirements unless he joins the services of a number of villages and, in many cases, connects the village pipes to the mains of the city. This requires that sizes through each village be ample to serve the communities beyond.

Detroit is an excellent example of forethought and plan in this matter. It has laid out a plan for the region it may reasonably serve, and requires towns taking water to lay their through mains in conformity with the plans (see *Engineering News-Record*, May 31, 1928, p. 855). Thus does the water-works engineer find himself with a regional problem on his hands, without legal authority or financial means to solve it except through the co-operation of the cities and villages dependent now or in future on a joint water supply.

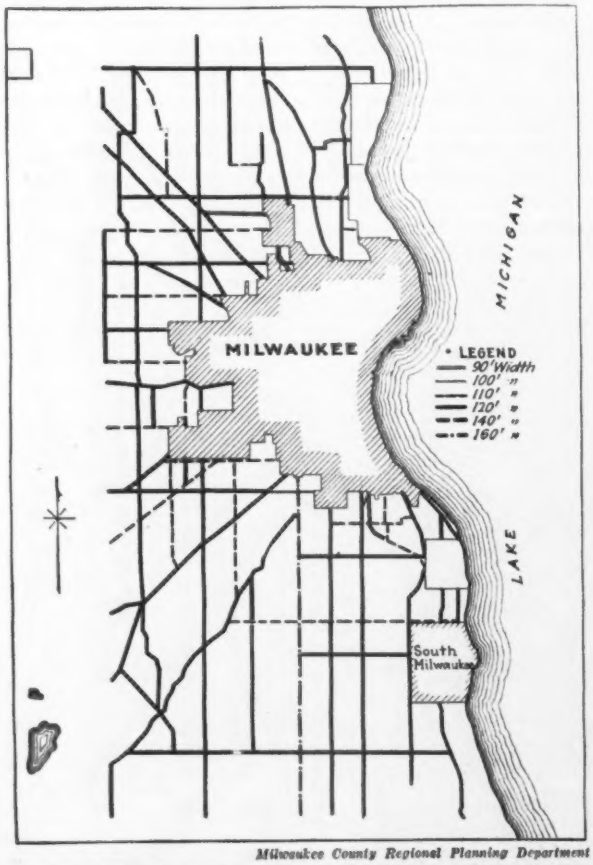
So also the engineers who undertake to provide sewers for a suburb often find that topography dictates an outfall through one or more adjoining municipalities. The resulting interdependence involves financial, legal and governmental negotiations—all growing out of the engineering exigencies.

The sewer problem is perhaps the oldest of those which have compelled regional thinking. It has required much thought and promotional education to effect results. The Passaic Valley trunk sewer in New Jersey serves a thickly populated region embracing many separate municipalities. It was proposed more than twenty years ago, but years of education, litigation and negotiation were required before it became a reality. Besides the multitude of municipalities, it involves the state and city of New York and the federal government. Boston had metropolitan boards to handle regional sewer and water problems even long before the Passaic organization. But these cases and a few others merely arose from needs that were considered highly special. Today there are similar regional problems aplenty. A recent sewerage problem, for example: certain suburbs of St. Louis must drain into the River des Peres conduit through Forest Park, and at once there arise urgent *regional* questions as to basis of payment, character of liquid permitted and type of construction.



Commonwealth of Massachusetts Metropolitan Planning Division

BOSTON INTERURBAN TRAFFIC CHART INDICATES COMMUTATION LIMITS OF THE REGION



Milwaukee County Regional Planning Department

MILWAUKEE COUNTY FOREHANDEDLY IS REQUIRING WIDE RIGHTS-OF-WAY ON ALL ITS MAJOR ARTERIES

Conflict of Utilities—Electricity and gas reach out everywhere. Utility engineers have managed successfully to install their lines and conduits through town and country, crossing political boundaries in whatever location seemed best to them. Since they were first, the next claimant for space in the highway must take what is left.

In the Chicago region this competition of utilities finally led to co-operative, regional consideration of suitable street-space allotment. The engineers of the utility companies, of the state, of the counties and of many of the cities, together with consulting engineers doing municipal work, got together under the auspices of the Chicago Regional Planning Association and agreed on apportionment of space and minimum standards of work. But this is an isolated result. Ordinarily no co-ordination between utilities or between towns is attempted; the regional problem is ignored, however much the work of the utility engineers may be of essentially regional character.

The foregoing illustrative cases might be greatly extended in number, but the situation will be obvious enough without this. In each instance the regional co-ordination has taken care of some individual engineering physical feature—sewage, water or transportation—but no comprehensive regional engineering, embracing all the factors, has been attempted. It will also be evident from the instances cited that topography and drainage boundaries are far more controlling in their effect on the problems of the region than are political boundaries.

Recently—within five years, certainly within ten years—co-ordination of *all* regional needs has been proposed in a few large cities. Half a dozen of the largest have found their regional problems become so acute as to command the attention of some far-seeing individuals who discerned the importance, magnitude and intricacy of the problem as a whole. And through the efforts of these men the first attempts at co-ordination, at regional-engineering thinking, have come about.

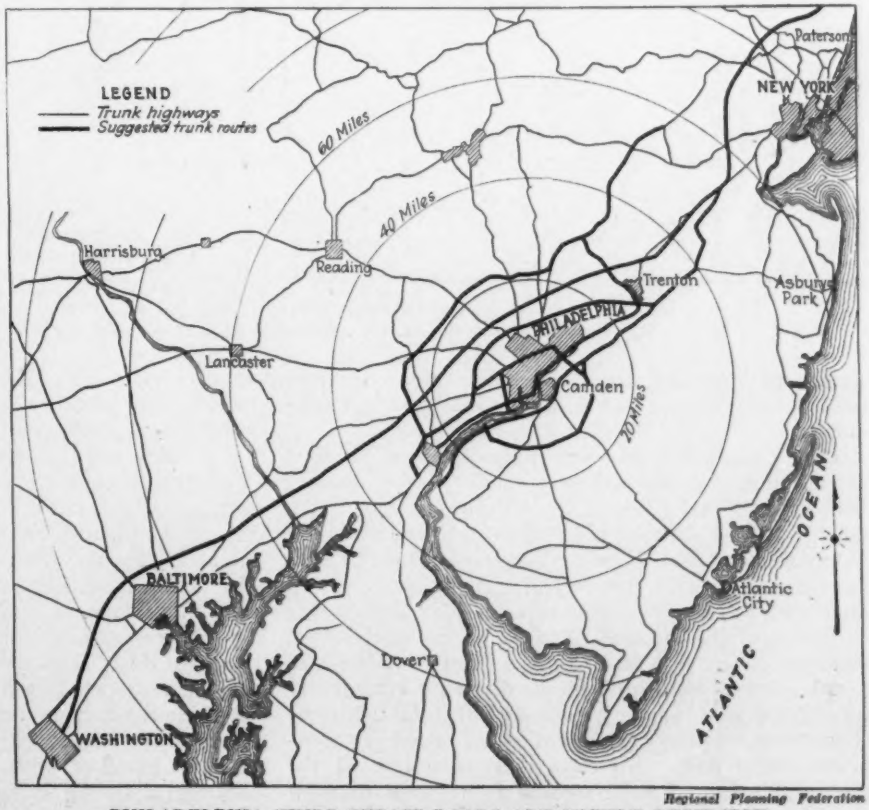
Methods of Regional Co-operation—There are almost as many methods of co-operation to effect regional service as there are states. *Illinois* has sanitary and water districts, park boards and commissions, forest preserves and conservancy districts. *Ohio* grants counties municipal rights to build water- and sewage-works by special assessment. It has a model conservancy-district law for flood control, which has been copied in *Colorado* and *New Mexico* and also has formed the basis for a conservation law in *Illinois* to care for water supplies and stream pollution. Sanitary district laws in *Illinois* and *Indiana* and other states permit contiguous municipalities to join in caring for sewage discharge and treatment where they have common problems. Park development in several states is carried on by extra-municipal boards or commissions. The pioneer example is the *Boston* Metropolitan District Commission, one of the earliest examples of regional planning. In several counties in *New Jersey*, in Westchester County in *New York* and in the case of Cook County Forest Preserve Commission in *Illinois*, county boundaries limit the park activities, though the boards in each case are largely or wholly independent of the county governments. So much can be said for the political set-up of officially organized bodies now existing to deal with single problems of regional communities.

Political Problems—The engineering problems of a region are seriously complicated by political problems. A mere glance at the map of any metropolitan region will bring some of these political problems to mind.

The boundaries of governmental units in any region are irregular and without reason—illogical results of haphazard growth. Areas of municipalities are often either so restricted as to hamper growth or so extended as to impose undue burdens on the well-occupied districts. Denver is overextended; taking in the whole county, it finds the cost of providing for sewerage facilities and water extensions extremely onerous. Similarly New Orleans has a hard time to provide money for extending city facilities into its sparsely built-up areas. Kalamazoo, on the other hand, is too confined; it must supply water and sewerage to areas round about, but finds that existing laws are such that it cannot easily annex territory.

We have, then, extra-city political problems arising. Hence new municipal organizations are created, but usually a separate one for each specific purpose. Park boards, water boards, sewerage districts and port authorities are formed, each—as in London and some other English cities—including that particular area over which the special need in question extends.

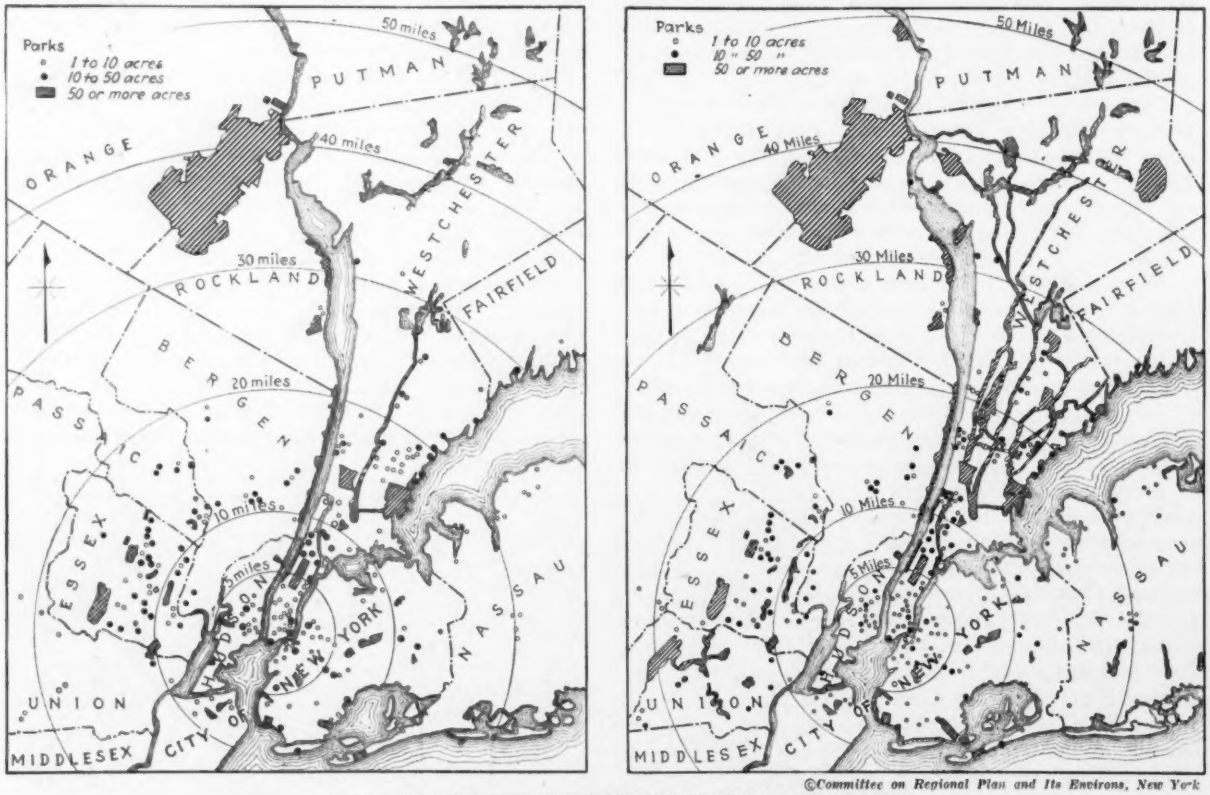
Some Troubles of Boards and Districts—These organizations soon encounter troubles of their own. First, the state, having authorized the formation of a district board, is tempted to control its personnel and expenditure. Second, overlapping jurisdictions cause disputes and antagonisms which make much work for lawyers. Third, a complex maze of organizations is created, which is a fertile breeding ground for conflicts and official jealousies and which is wholly unable to retain public confidence. Thus, while the Chicago region (as later defined) contains nearly 1,000 municipal bodies, the city of Chicago alone is burdened with no less than 35, superimposed on the normal municipal government. That under these circumstances the state has limited the taxing powers of several boards and districts rather narrowly is most fortunate.



Regional Planning Federation

PHILADELPHIA FINDS BYPASS ROADS ARE HIGHLY DESIRABLE IN REDUCING CONGESTION

If any real progress is to be made from this hopelessly tangled condition, new concepts must be developed and become part of the citizen's every-day thinking. The reality of the new physically bounded unit, the *metropolitan region*, must be brought clearly before the general public consciousness. Until a sufficient number of people have given thought to the problem to know its requirements and the possibilities of co-ordinated effort, it will be neither possible nor advisable to grant political recognition to the region and accord it legislative powers. Before that time it will be essential to utilize existing governmental units to the limit; otherwise competition, rivalry and jealousies will follow. At present too many city officials are unable to see beyond their boundaries and they must learn to appreciate the need for orderly development beyond the city confines before this new unit, the region, can be brought into existence successfully.



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PARK DEVELOPMENT, METROPOLITAN AREA, NEW YORK
Major park areas; at the left the condition in 1921, at the right the same area in 1927.

The Beginning of Regional Study—Regional planning organizations, mostly voluntary and purely advisory bodies, are in existence in New York, Chicago, Philadelphia, Boston, Buffalo, Los Angeles, Detroit, St. Louis, Milwaukee and Washington. They are engaged in making a complete plan of the region, bringing onto one map all of the facilities of a certain nature, with a view to their easier study. In this work the mere placing of the street and road system on a map has often been of such educational value to municipal officials that they immediately set about finding ways of effecting better through-route connections, bypasses and short street openings to expedite traffic flow. No clearer demonstration of the clarifying effect of even elementary regional thinking could be asked!

Often such a study discloses a ridiculous non-meeting of street paving in adjacent towns. An example is that of the Indiana municipalities at the lower end of Lake Michigan, which years ago began to grow together. Until the Chicago Regional Planning Association brought their separate pavement maps onto one sheet there was but a single through street around the lower end of Lake Michigan, and that one miserably paved in places. So soon as the consolidated map was drawn, future paving programs were quickly (and without local opposition or stubbornness) readjusted to serve traffic rather than accommodate merely the adjoining property holder.

Important new routes have been planned by some of these volunteer organizations. At Philadelphia a way was found whereby a small outlay made it possible to bypass through traffic. The improvements suggested were so obvious that the officials accepted them without the formality of citizens' committee hearings and without being forced into line by political pressure.

In Chicago the regional association has proposed a comprehensive water system which will be valuable as a starting point when the fringe and satellite cities grow beyond the capacity of their well supplies. It will form the basis of a metropolitan water district, a development that is inevitable, since Lake Michigan is the only logically available supply. No other existing agency is in a position financially to attempt such a study. Quite in the same sense, Milwaukee suburban areas are now agitating a metropolitan water district, with the Milwaukee supply as the nucleus and main source. In that case the county will probably be the political unit, as already it has done excellent work in co-ordinating highways and effecting a zoning ordinance. Already a Milwaukee Metropolitan Sewerage Commission is in existence closely associated with the City Sewerage Commission.

So the beginnings of regional thinking and regional coordination are in existence in some places.

The Committee on Regional Plan of New York and Its Environs has set up perhaps the most elaborate program of all the volunteer organizations. Financed privately and lavishly, it has gathered many classes of valuable data on the metropolitan region. Its ultimate aim is an ideal plan toward which the region should grow. Most of the other associations, though having an ideal plan always in the background, have mainly concentrated on making their work of immediate usefulness to existing bodies, steering the course of the officials so as to improve and avoid obvious errors of the past. In this view the Chicago association has attempted to have on its committees representatives of all of the interested agencies, so that when plans of new work or of changes are adopted the officials who are to carry them out will have had a part in their making.

Prospective Developments in Regional Work—While the form of any non-official organization set up to handle engineering may be varied as desired, official organization must conform to law. Few if any of the present regional planning associations are official, but there has been a movement in a few states to make them so and to provide for their support by taxation.

Official status is desirable in that it would provide finances for a continuing program. On the other hand, the danger of political influence is so great that competent men might be unwilling to enter the field. Volunteer associations, financed privately by individuals, chambers of commerce and other civic-minded associations, are likely to be the mainstay of those engaged in regional engineering for some time.

The present trend is toward a combination of the Chicago and New York ideals: working toward a master plan but always having ready one element of that plan for immediate execution, besides a program of activity for definite periods ahead. Regional engineers are learning, as city engineers have already learned, that the public will take fright if too much is presented for immediate execution, but that without comprehensive, well-scheduled programs, looking years ahead, regional engineering cannot meet regional needs.

Some of the elements which underlie regional engineering and on which its opportunity, desirability and necessity in the broadest sense are founded, may be enumerated as follows: Increased development of the metropolitan areas; growing together of municipalities; slowing down of annexations to the large central city; speeding up of real estate subdivisions due to the money urge; decrease of the time-distance factor owing to the increase in transport facility; increase of community requirements or joint needs; enhancement of travel-zone demands as evidenced by the rapid development of new streets linking together adjacent municipalities; the effect of increased valuations in compelling better use (hence planned use) of the land, so that the old, new and revised layout will fit together harmoniously; and, finally, modern social, political and economic needs, which demand a new appraisal of present facilities in the light of facilities more recently made available. The whole subject is a challenge to the engineer.

©Fairchild Aerial Surveys

NEW YORK, WHERE REGIONAL ENGINEERING MUST DISREGARD BOTH NATURAL AND ARTIFICIAL BOUNDARIES
Looking southwest from over Long Island, showing part of Brooklyn, the East River with three of its bridges, the lower end of Manhattan Island, the Hudson River, part of Jersey City, New Jersey, Bayonne, Newark Bay and in the distance Newark and Elizabeth.

Gate Tower, Tilted by Ice, Returns to Position

Concrete Intake Tower at Magic Dam, Idaho, Cracks Around Base When 16-In. Ice Sheet Thrusts Against Upper Part

By George N. Carter
Commissioner of Reclamation, State of Idaho

THE MAGIC DAM is a hydraulic-fill structure built in 1909 on the Big Wood River in Idaho to store water for the Idaho Irrigation Company. It is 135 ft. high, 625 ft. long on the crest and creates a reservoir whose capacity is 192,000 acre-ft. In March of this year, at a time when the reservoir contained 115,000 acre-ft. and was covered with a solid ice sheet 16 in. thick, the concrete intake tower from which the intake gates are controlled began to lean toward the dam. This tilting, apparently due to ice thrust, caused the tower to crack around its base and through this crack there was heavy leakage into the tunnel. This leakage continued for four days and reached a maximum of 370 sec.-ft. The tower then gradually settled back into position, practically closing the crack and almost completely shutting off the leakage.

Water is ordinarily admitted to the tunnel, as shown in the drawing, through two sets of gates, each pair consisting of a sluice gate and a 60-in. gate valve, arranged in tandem. These intakes are supplied from the half of the intake tower away from the dam, this side being at all times open to the reservoir. The other half of the tower is designed to be kept dry and consists of two manways leading down to the valve chambers at tunnel level. Normal leakage through the gates over a long period of time has been found to be 20 sec.-ft. The flow through the tunnel, as recorded by an automatic gage located just below the dam, is given in the accompanying table, which covers the period involved in the recent ice trouble.

The increase in flow was first observed by the gatekeeper on March 6, when it had reached twice the normal amount. The next day it had increased to alarming proportions and the tower was discovered to be leaning toward the dam. On March 8, with a maximum leakage of 370 sec.-ft., the tower was estimated to be out of perpendicular 8 ft. at the top.

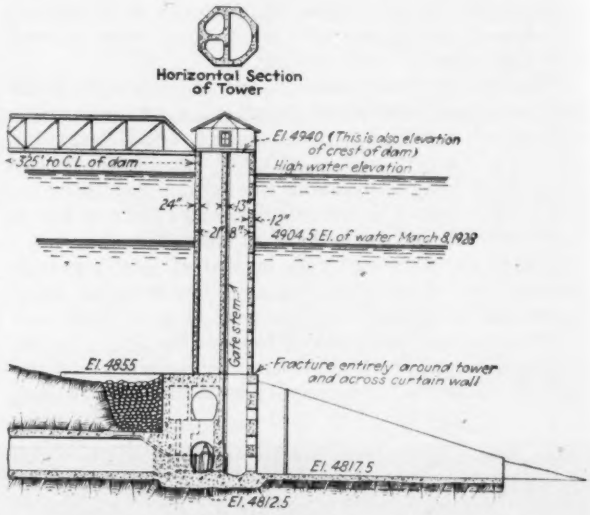
Date	Leakage, Sec.-Ft.	Date	Leakage, Sec.-Ft.
Feb. 24	20	March 7	205
25	25	8	370
26	26	9	320
27	26	10	193
28	27	11	38
29	27	12	35
March 1	28	13	35
2	28	14*	29
3	28	15*	23
4	28	16	20
5	35	17	20
6	40	18	20

*Crack at base of tower was calked.

The only openings into the tunnel from the manways that go down to the gate chambers are a 6-in. drain pipe in each compartment and a stop-log opening through the floor, 9 in. wide and 9 ft. long. At the time of maximum discharge of the leak water rose in the manways to reservoir level, indicating that the openings into the tunnel were discharging their full capacity under reservoir head.

On March 9 the leakage began to decrease and two days later it was approximately the same as when the increase in leakage was first noted; moreover, the concrete tower had settled back into place and again was apparently plumb. Investigation in the gate chambers disclosed an almost continuous sheet of water coming in through the curtain wall from the other half of the tower and from the outer wall of the tower along the semi-circumference toward the dam. The sheet had the least thickness on the side toward the dam.

On March 14 a diver arrived at the dam and after inspection reported a fracture of the concrete in the tower structure extending entirely around the base of the tower and across the curtain wall between the wet and the dry chambers. When the crack had been calked with oakum the leakage from this source was entirely stopped.



GENERAL FEATURES OF THE INTAKE TOWER AT MAGIC DAM

A study of all attendant conditions leads to the conclusion that the solid ice sheet on the reservoir, being constantly kept free around the edges by the raising of the water level, moved slowly toward the dam, forcing the heavy concrete tower out of plumb. For some unexplained reason the direction of movement of the ice was later exactly reversed so that the tower was returned to its original position without the slightest rotation. No high wind or other natural phenomenon which might have accounted for the movement of the ice sheet is known to have occurred.

Immediately after the tower movement the gates were tested for operation and were found to be movable. The sluice gates are operated by stem and hoist from the tower top, while the gate valves are connected by sprocket chains to operating mechanisms at the tower top. During the period of maximum leakage both sprocket chains were broken and afterward only enough links could be found to make up one chain.

After the tower settled back to original position it was thought advisable to reduce the danger of any horizontal movement as far as possible, and to this end collars of 12x12-in. timber were framed and fitted into each of the manways at the line of fracture, the framing being forced firmly against the concrete by jacks and struts. Some permanent repair will be undertaken when the irrigation season is over and the reservoir can be emptied without inconvenience.

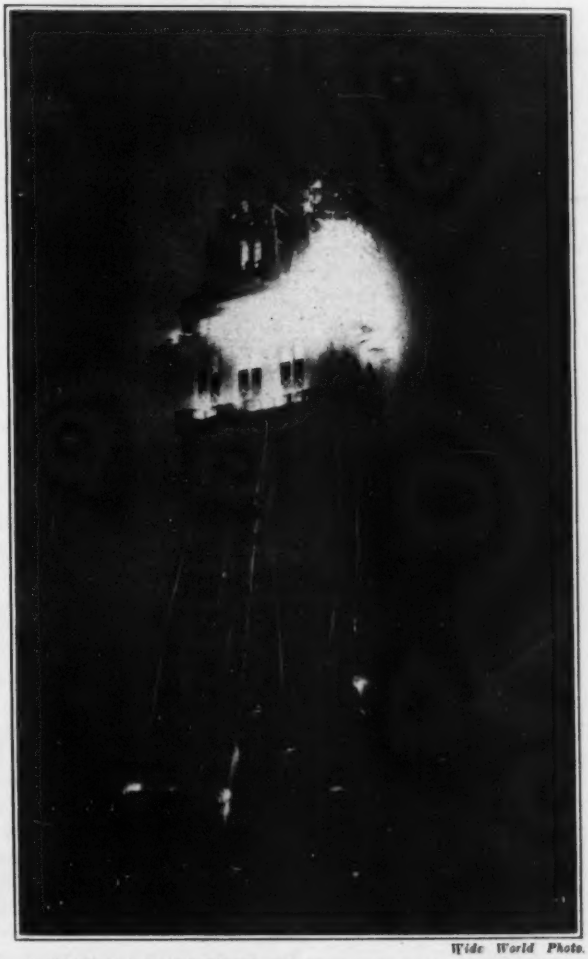
Methods of Reducing Fire Hazards During Construction

Dollars Lost by Neglect of Simple Precautions, Lack of Emergency Extinguishing Apparatus and Regular Watchmen

By O. J. Swander
Engineer, Kansas Inspection Bureau, Topeka, Kan.

THE fire hazard existing in buildings and other structures during the construction period is seldom properly appreciated, although losses at this stage have been both numerous and costly. Even fire-resistive structures have been seriously damaged before completion, usually because of the large amount of timber used in the forms and falsework, the carelessness of the workmen and the lack of proper fire-protection facilities.

Two well-known examples of construction fires still comparatively recent are the Sherry-Netherland Hotel fire, described in *Engineering News-Record* of May 21, 1927, p. 665; and the destruction of part of the Mount Washington Boulevard bridge in Pittsburgh (*Engineering News-Record*, Sept. 1, 1927, p. 359). The Sherry-Netherland fire started on the 38th floor and worked its way down to the thirteenth floor, despite the fact that the building was of modern fire-resistant construction and was practically completed. The loss was $516,000. In Pittsburgh, fire in the falsework of the Mount Washington bridge occurred when the pouring of the main arch ribs was practically completed, resulting in their collapse and destruction with a loss of $81,000. Many other similar cases have occurred, proving that the construction superintendent should give as careful attention to fire safety as he does to any other problem.



Wide World Photo.

BURNING FALSEWORK OF THE NEARLY COMPLETED SHERRY-NETHERLAND HOTEL, NEW YORK CITY
The light streaks in the picture were caused by the fall of blazing timbers to the street.

Temporary Structures—Usually one of the first problems in getting a job under way is the construction of temporary storage sheds, shops and offices. While the layout of construction equipment and the amount of space available determine the placing of the buildings, it is usually possible, by a little foresight, to minimize the conflagration hazard by placing the buildings where they will be properly isolated from one another and easily accessible to fire apparatus. These temporary buildings should contain as little combustible material as possible. The use of the semi-portable metal buildings, or of buildings covered with corrugated iron, sheet metal or fire-retardant roofing, is advisable. Each building should rest directly on the ground or on a tightly inclosed foundation to avoid the accumulation of trash and rubbish under the floor. Separate and well-isolated buildings should be provided for the storage of oil, paint, explosives, gasoline and other hazardous materials.

Forms and Scaffolding—The use of incombustible material in place of lumber for concrete forms, scaffolding, material hoists and similar equipment is made possible by modern developments. On most projects, however, lumber cannot be entirely eliminated. While awaiting use this lumber should be stored in piles not over 10 ft. high, with a clear space of 10 ft. or more between the piles. The lumber should be piled solidly—the so-called stick-piling method, which provides circulation of air through the pile, enables a fire to spread very quickly. The accumulation of shavings, sticks and other combustible refuse between the piles should not be allowed. In fact, it is of great importance to keep the entire construction area cleared of this refuse. All trash should be hauled away each day, or burned in a safely arranged incinerator. It is especially important not to allow the accumulation of waste material in chutes. A recent fire in Cambridge, Mass., was caused by the dropping of a cigarette butt down a waste material chute. The fire started at the base of the chute and could not be extinguished because no suitable equipment was available.

Hazardous Equipment—Modern construction methods are necessarily dependent upon certain processes which introduce severe fire hazards, but the danger can be decreased if the proper safety precautions are taken. Acety-

lene cutting and welding equipment, gasoline torches, charcoal pots, forges and rivet furnaces all introduce special risks. Such apparatus should be kept in good order and should be well protected from accidental contact with inflammable material. Charging, cleaning and repairing of generators and acetylene equipment should be done during the daylight hours only. One precaution which should be taken is to clean the generator thoroughly each time it is recharged. Leaks or other defects, either in the apparatus or in its connections, should be promptly repaired. Carbide should be stored in a separate building, and not more than one drum at a time should be taken on the job. Burning pots and furnaces should not be used on unprotected wooden floors or near highly combustible materials. Furnaces containing hot coals should not be left in the building after working hours. Tar pots should not be filled too full, and should be carefully tended to see that they do not become too hot and boil over.

Gasoline and kerosene engines also introduce some fire hazard, usually because of the handling and storage of fuel. An engine should never be filled while it is running. Only enough fuel should be brought into a building for one filling, and this should be in an approved safety can. A clearance of 6 in. should be maintained between the exhaust pipe and any combustible material. Electric motors, although the safest source of power, are hazardous if used in rooms containing combustible dust or inflammable vapors. Special types of inclosed motors are available to minimize this risk. All electrical equipment should be installed in compliance with the requirements of the National Electrical Code. If the construction equipment includes a boiler, a clearance of 3 ft. should be maintained between the boiler or boiler breeching and all combustible material. If the stack passes through woodwork, a thimble and umbrella should be provided, and an 18-in. clearance should be maintained.

Winter construction brings certain additional fire hazards. One of these is the necessity for heating concrete aggregate during freezing weather. A common method of heating stone and sand on small operations is by a fire in a metal culvert or section of an old smokestack. When this method is employed, the operation should be conducted at a safe distance, and the fire should be carefully extinguished each night. The safest method of heating aggregate is by steam coils.

Stoves or salamanders should be used with precaution and should not be set up on unprotected wooden floors. If the structure is temporarily inclosed with canvas, the stoves or salamanders should not be set where the canvas can be blown against them. Although brick chimneys are the safest for stoves, their use is impracticable if the stove is for temporary use only. When metal flues are used, the opening where the pipe passes through woodwork should be provided with a metal thimble, and a 6-in. clearance should be maintained between the flue and all combustible material.

Extinguishing Apparatus—The importance of having proper fire-fighting apparatus always near at hand is emphasized by the many cases of destructive fires on construction work which could have been extinguished at a trifling loss had proper provision been made in advance. Chemical extinguishers, hand water pumps, water casks or pails and sand pails should be available on every construction site. The 2½-gal. anti-freeze type extinguisher is probably the best for general installation. Water pails may be kept charged during winter months if a calcium chloride brine is used. The pails should have round bottoms so that they will not be carried away by the workmen for other purposes. Carbon-tetrachloride extinguishers are effective on electrical fires. Oil fires may be extinguished either by foam extinguishers or by dry sand. The installation of fire pumps, standpipes and hydrants and the placing of the fireproofing should follow the construction work as closely as possible. The fire loss in the Sherry-Netherland Hotel building would probably have been negligible if these precautions had been observed. An 8-in. standpipe had been completed up to the tower, but as it had not been connected and there was an opening on the 22d floor, all water pumped into the standpipe was wasted. In addition, no means had been provided for the firemen to reach the upper floors. Delaying the fireproofing until a building is completed makes it possible for a fire to wreck the structure.

When the work is located in a city or town with hydrant protection, main reliance will be placed upon the public fire apparatus. Before construction begins definite arrangements should be made for calling assistance. Usually city buildings have fire alarm boxes as one of the built-in features, and it is important to install this equipment as quickly as possible. If there is no public fire alarm system near at hand, a telephone should be provided. Means should always be provided for fire apparatus to reach the construction site, and all parts of the premises should be accessible. It is especially important to provide elevators, stairs or other means by which the firemen can quickly reach the upper floors of a building.

If the construction work is beyond public protection, it is advisable to provide 35-gal. double-tank chemical extinguishers. Many fire departments extinguish 90 per cent of their fires with these. They must be housed in heated quarters during freezing weather. If the construction equipment includes a pump, this can be used effectively if hose and nozzles are provided.

It is important to have a watchman on the premises at night and at other times when construction work is not in progress. If the job is part of a plant already in operation, it is usually possible to extend the watchman service to include the new work.

Every construction project presents a new problem, and only general rules for safety can be laid down. The construction engineer should be alert to recognize fire hazards and inform the workmen regarding them. The importance of fire prevention should be stressed at all times, and definite instructions should be given the workmen for safeguarding hazards, turning in fire alarms and handling fire-extinguishing appliances. Proper preparation for preventing and fighting fires may mean the saving of thousands of dollars from useless destruction.

New York State Work Reduces Unemployment

Highway and building construction by the State of New York has been speeded up during the current season in order to relieve the unemployment situation which existed earlier in the year, with the result that at the present time there are in force 221 highway contracts, totaling 897 miles and costing $46,111,636; 244 highway bridge contracts costing $3,479,881; eighteen grade-crossing eliminations costing $981,000; 165 public-building contracts costing $28,501,749; and seventeen canal contracts costing $1,300,918. Extra appropriations by the legislature have been made possible this heavy program.

Algæ Control by Creating Turbidity at Louisville, Ky.

Copper Sulphate and Other Means Proving Inadequate to Maintain Filter Runs, Dredge Pump Used to Increase Turbidity

By W. H. Lovejoy
Superintendent of Filtration, Louisville, Ky.

Among the Many Troubles of the operators of water-filtration plants is the shortening of runs between washing, which cuts down output by lessening filter capacity and increasing the volume of wash water required. The algæ growths are at their worst when the raw water has a low turbidity. So far as we know, the creation of artificial turbidity to forestall algæ troubles was never used until the season of 1927, at Louisville. Methods and results are described in the following article. —Editor.

THIS is a preliminary report of experimental work at the Louisville water-filtration plant in creating artificial turbidity to eradicate micro-organisms which cause short filter runs. After experiencing recurring sieges of organisms regularly each summer for about eighteen years, with their serious and sometimes nearly disastrous effect on plant operation, it was decided to try out a new scheme of treatment for this purpose. The first trials of this treatment were made during two periods in the summer of 1927 in which organisms were present. Unusual and perhaps radical as this scheme may seem, it was seized upon as offering a possibility of relief after repeated failure, or at least indifferent results, of other remedies that had been tried out in previous years. Our hopes seem to have been justified, but trial more than one season is needed before reaching a final conclusion.

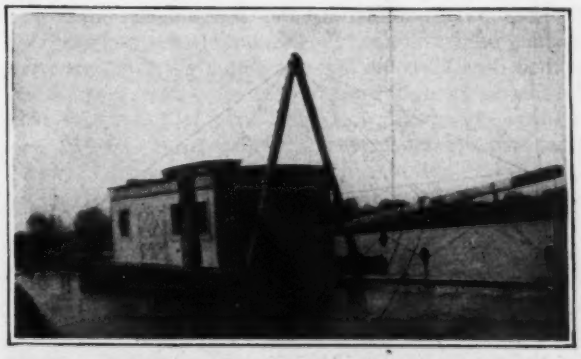
Dredging Equipment—A dredge boat with hull 20x40 ft. in plan and 4 ft. deep was built on the preliminary settling basins. This boat carries an 8-in. electrically operated dredge pump and necessary winch apparatus to operate slewing lines that fasten to the walls of the basin. The pump has a flexible suction line with a special suction hood that holds it off the bottom the proper distance. Fifty pontoons floated on barrels carry the 8-in. discharge line and the electric cable.

The dredge was installed originally for the dual purpose of cleaning the reservoirs and furnishing artificial turbidity when needed during algæ periods. The dredging equipment was all designed and its construction supervised by a dredge expert and its operation guaranteed by him. It has exceeded our expectations in its efficiency both for cleaning and for creating turbidity. We furnish our own power for its operation and it is handled by our own men without difficulty.

For cleaning the reservoirs the discharge line is connected on the reservoir bank to a drain by means of two universal joints. This drain carries the mud from the dredge line back to the Ohio River, 2 miles distant. By this means the reservoir can be cleaned without draining and at a cost of about 3c. per cubic yard. This is about half the cost of the former method of cleaning, which also required the draining of the basins during the period in the summer when we could least afford to have them out of service. The dredge pump is designed to handle 60 cu.yd. of solids per hour on a basis of 10 per cent solids. Our tests showed an average of over 15 per cent while working in a 27-in. depth of mud.

To diffuse mud through the basins for artificial turbidity, the discharge line is disconnected from the drain and allowed to discharge the mud from the dredge into the raw water at the inlet of the basins. In either operation, for cleaning or diffusing mud, the dredge is kept moving slowly back and forth over new areas by means of the winch and slewing lines, which are fastened to the bank.

DREDGE AND PONTOON LINE AT LOUISVILLE



TACKLING ALGÆ WITH A DREDGE PUMP
The dredge built for removing sediment from the Louisville settling basins is used also to produce artificial turbidity and thus check algal growths which, unchecked, sometimes cut the filter runs to an hour and diminish filter yield by 20 per cent.

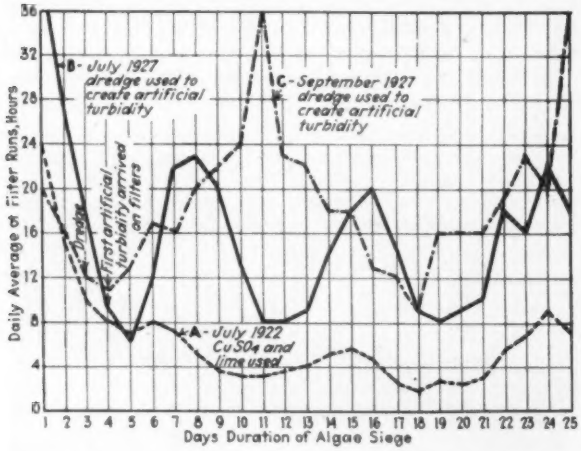
The writer had previously heard mention of artificial turbidity on a small scale in laboratory work, but had never before heard of it having been actually produced on a large scale in a practical way. The basic idea of utilizing artificial turbidity to combat algal growth came really from observing Nature's way of eliminating algæ in our river water. We have often observed that during a siege of algæ the appearance of as little as 50 or 75 p.p.m. of turbidity in the river causes the disappearance of algæ and the filter runs begin to lengthen as a result. Therefore we worked out this method whereby we could stimulate these conditions and reproduce them in our reservoirs at will, hoping that the artificially created turbidity in the reservoirs would do in part, at least, what the natural turbidity of the same amount and character does in the river.

First Trials of Artificial Turbidity—Our first opportunity to use the dredge in stirring up mud for artificial turbidity came during the summer of 1927. On July 4 the filter runs started dropping. The river water then had a turbidity of 18 p.p.m. and contained 1,000 micro-organisms per cubic centimeter. The average filter runs

were twenty hours, having dropped from 48 hours the previous day.

Two days later (July 6) the runs averaged about ten hours. By July 8 runs had dropped to three hours. The dredge was started on July 6 and the first turbidity-treated water arrived on the filters during the day on July 8. Late on July 8 the filter runs had recovered an average of three hours in length. By July 9 the runs were from 15 to 25 hours in length.

The dredge was thereafter operated for five hours daily until the end of the month, when natural turbidity appeared in the river. Although during the rest of the month the runs fluctuated above and below the high point attained on July 9, they averaged about twelve hours in this period. This length of run is well above the danger and trouble point and is far above anything that we had been able to do in previous years under the same water conditions. During this period the organism


B - July 1927 dredge used to create artificial turbidity
C - September 1927 dredge used to create artificial turbidity
First artificial turbidity arrived on filters
A - July 1922 CuSO4 and lime used
Daily Average of Filter Runs, Hours
Days Duration of Algae Siege

COMPARATIVE RESULTS WITH ARTIFICIAL TURBIDITY AND COPPER SULPHATE FOR ALGÆ CONTROL AT LOUISVILLE

River conditions practically the same during the three periods represented by the curves.

counts varied from 100 to 1,000 per cubic centimeter with large amounts of amorphous organic matter present.

In September we had a siege of organisms lasting for about twenty days. During this period the river turbidity averaged 10 p.p.m. and the organism count 1,000. On Sept 12 the filter runs were down to six to eight hours. On this day the dredge was started, creating turbidity, and on the 14th after the first treated water arrived on the filters, the runs started upward and were at 20 to 25 hours by the 16th, averaging about fifteen hours for the remainder of the period. The dredge was again kept in operation for about five hours each day until the end of the month, when the organisms disappeared.

We believe that the tabulation of algæ sieges, giving general details and results of previous treatments, along with the results for the past year as a comparison, are quite instructive. It would appear that treatment by artificial turbidity stopped the filter runs on the down grade at a point three or four times the usual and expected minimum. Also, the treatment apparently thereafter increased the runs to an average for the remainder of the periods to a figure which is two to three times the average for the previous periods.

While there were some fluctuations downward in the runs after the first increase, at no time during these two sieges were we under the severe strain of plant operation or were we near the danger point in high wash water consumption and plant output that we have usually been laboring under during most previous sieges.

In the light of our limited experience with artificial turbidity, it is quite possible that, with further trials of this method, improved manipulation may give us a material increase in efficiency; but we realize that these two trials hardly warrant a final prediction as to its success. We are much gratified with the results so far and are hopeful of even better results in the future. As a consequence of our experience so far with the method, we have learned quite a few points that will be helpful to us in future work along this line.

One important conclusion that seems evident is that the shortening of filter runs results from a gradual accumulation of organisms on the filter sand—that is, more organisms and amorphous matter are collected and held on each successive run and few are removed by each successive wash. This holds good as long as the incoming water is clear and contains large numbers of organisms. This points to the necessity of starting the remedial treatment soon enough to remove the organisms from the incoming water at their first appearance to prevent their accumulation on the sand bed. After the organisms become heavily matted on the sand bed they are difficult to remove. For this reason we intend in the future to start artificial turbidity work whenever the turbidity in the river gets below 50 p.p.m. and the runs show any appreciable drop.

With five hours' running of the dredge enough mud can be stirred up to carry to the coagulating basins a turbidity of 75 to 100 p.p.m. for about 24 hours. At the point of discharge of the mud from the dredge at the inlet of the north basin the turbidity averages about 500 p.p.m. About 60 per cent of this is lost through settling in traveling through this basin, leaving 200 p.p.m. at the entrance to the south basin. From 20 to 50 per cent of this amount is lost in passing through this basin, leaving about 100 p.p.m. going into the coagulating basin. The loss of nearly 80 per cent of the original turbidity is not a bad feature in this case, as it carries with it a large number of the organisms during its subsidence. The residual turbidity of 100 p.p.m. entering the coagulating basin is sufficient to provide a nucleus for an excellent floc which carries down an additional quantity of organisms, thus removing an additional number before the water goes to the filters.

In other words, the main idea of this scheme is to remove as many of the organisms as possible by subsidence, good coagulation and consequently improved washing of the filters. To substantiate the fact that this method does keep the organisms to a great degree from the filters, the following figures comparing the number of micro-organisms per 1,000 c.c. without and with artificial turbidity are given:

	Without*	With
River water	600	850
Settled water	400	100
Coagulated water	375	36

*The river water had a turbidity of 10 p.p.m.

Bacterial Effects—It has been rather expected that the stirring up of the settled mud in the reservoirs would result in more or less increase of bacteria. However, this proved to be not the case. All during this work the water leaving the basins was lower in bacterial count and B. coli content than the incoming river water.

Effect of Sand Size on Filter Runs—Another fact that

we have found as a result both of this recent work and of previous work may be of interest in this connection. We have found that a filter unit equipped with sand of 0.48 to 0.50 mm. efficient size under our conditions will run on an average 50 to 100 per cent longer, during short run periods due to algæ, than one having a sand of 0.40 mm. efficient size; also, the unit with finer sand

ALGÆ TREATMENT BEFORE AND WITH USE OF ARTIFICIAL TURBIDITY

Year	No. of Sieges and Duration	Av. Length Filter Runs	Minimum Runs	Organism Counts	Av. Turb. River	Treatment Used	Results
1910	1– 7 days	2.5	1.5	3,000	10	$CuSO_4$	Gain 9 hr.
1911	2– 30 days	8.0	5.0	600	10	$CuSO_4$	Gain 9 hr.
1912	1– 17 days	8.0	4.0	1,200	8	$CuSO_4$	None
1913	2– 34 days	2.5	1.0	900	30	$CuSO_4$	None
1914	2– 37 days	2.5	1.0	1,000	5	$CuSO_4$	None
1915	1– 13 days	4.0	2.5	900	8	None	.....
1916	3– 48 days	1.5	0.5	Qual. exam. only	25	$CuSO_4$	Gain 3 hr.
1917	1– 46 days	5.0	1.0	Qu. ex. only	18	$CuSO_4$	Gain 2 hr.
1918	1– 20 days	10.0	6.0	Qu. ex. only	25	None	.....
1919	1– 15 days	10.0	6.0	Qu. ex. only	20	None	.....
1920	1– 29 days	4.0	0.5	Qu. ex. only	16	$CuSO_4$	Gain 2 hr.
1921	1– 30 days	7.0	3.0	Qu. ex. only	20	$CuSO_4$	Gain 1 hr.
1922	1–132 days	6.0	0.5	Qu. ex. only	25	$CuSO_4$	None
						Lime	None
						NaOH	None
						Alum cut out 67 days gave best results	
1923	1– 57 days	6.0	3.0	Qu. ex. only	25	Preel.	None
						$CuSO_4$	None
						No alum	Slt. gain
1924	2– 89 days	5.5	2.0	Qu. ex. only	20	$CuSO_4$	None
						No alum	Slt. gain
1925	None	...	...	.....	..	.....	.....
1926	None	...	...	.....	..	.....	.....
1927	1– 21 days	14.0	3.5	550–1,300	13	Art. turb.	Gain 15 hr.
	1– 21 days	15.0	6.0	600–1,500	11	Art. turb.	Gain 8 hr.

will drop off in length of runs faster and regain more slowly than one with the coarser sand.

Previous Efforts at Treating Algæ—In our previous efforts at solving this problem I believe we have tried out about all of the schemes that one could suggest. Among the many methods tried are the following: (1) Copper sulphate treatment in varying doses, both continuously and intermittently, at every available point of application; (2) lime dosage in coagulating basins; (3) overdosing with alum; (4) coagulation with sodium aluminate and alum; (5) prechlorination in subsidence basins; (6) treatment of filter sand with copper sulphate, caustic soda and hypochlorite.

None of these methods ever gave much relief or even any promise, with the single exception of copper sulphate. It is true that copper sulphate used to afford us some temporary relief when our subsidence period amounted to four days or more. However, our recent experience has been that it does little good with less than this period. It is also a well-known fact that copper has two bad results—heavy aftergrowths of bacteria and liability of causing tastes due to sudden breaking up of the organisms.

This problem of short filter runs is one of paramount importance at the Louisville plant. The trouble becomes so extreme at times that it threatens to curtail our water supply. With filter runs of 30 to 60 minutes and wash water consumed at a rate of 12 per cent of the volume filtered, a plant cannot run very long with safety. The Louisville plant has actually operated under such conditions several times. At such times the actual lost capacity due to excessive wash water and time lost in operating filters is 20 per cent. A problem as serious as this requires a remedy that is always effective and not one that works once in a while. That is what we are after now and we think we have found it in artificial turbidity.

Shrinkage Effect of Celite in Mortar and Concrete

Shrinkage of 1:3 Mortar With More Than 2 Per Cent Celite Increases 10 to 25 Per Cent, While Tests Show Concrete Is Less Affected

By A. S. Levens

College of Engineering and Architecture, University of Minnesota, Minneapolis

RECENT studies of the effect of the admixture of Celite in mortars and concrete have dealt primarily with the factor of workability. Few studies have been made of the shrinkage effect of this admixture, and the tests described below, which were conducted in the experimental laboratories of the University of Minnesota, are therefore presented as of interest.

Shrinkage Effect on Mortars—Two series of 2x2x 10-in. 1:3 mortar beams were made and tested. Each series consisted of seven sets, two beams in each set, containing amounts of the admixture varying from none to 6 per cent, based upon the weight of cement. The beams of the first series were kept in a moist chamber for the first 24 hours, left in air at 70 to 75 deg. F. for 53 days, placed in water for seven days and then in air. Results of these tests are shown in Fig. 1. The beams containing the admixture show greater shrinkage than the plain beams. At the end of three days the shrinkage was about 30 per cent greater than in the plain beams; at the end of seven days about 15 per cent; and at the end of 28 days about 10 per cent.

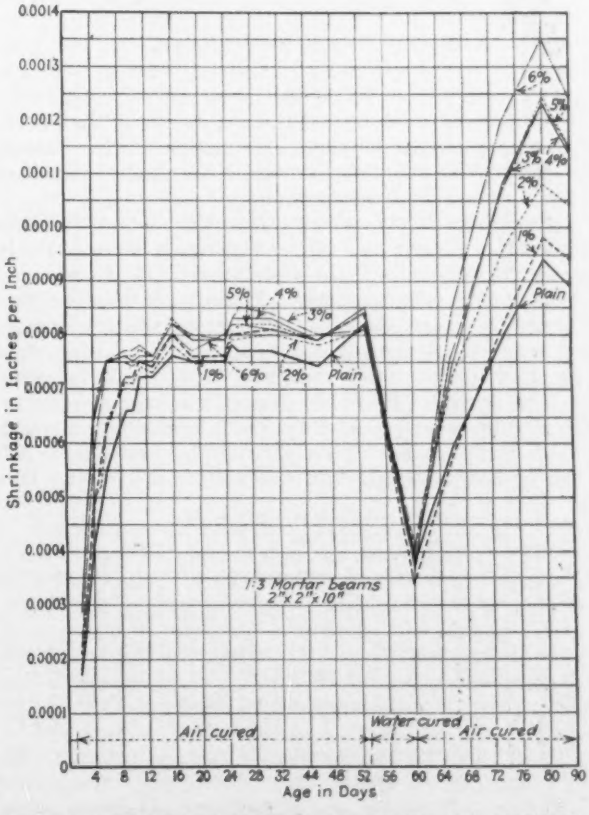


FIG. 1—SHRINKAGE EFFECT OF CELITE ON MORTAR BEAMS WITH AN INITIAL AIR CURING OF 52 DAYS

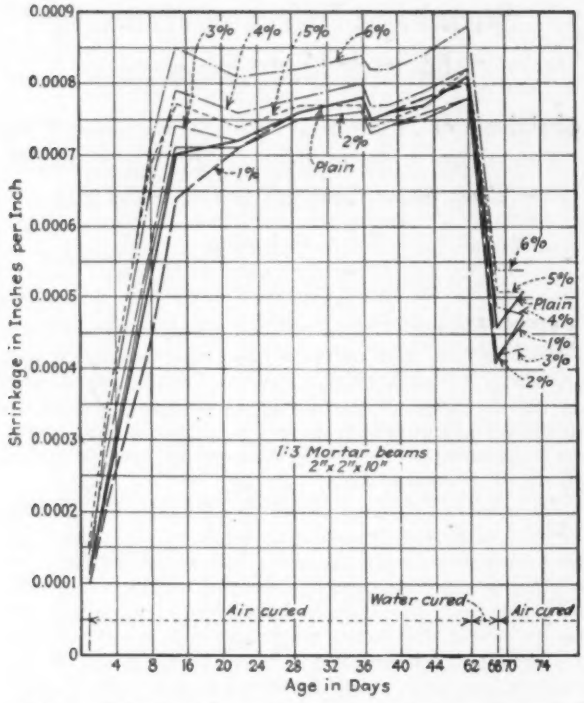


FIG. 2—SHRINKAGE EFFECT OF CELITE ON MORTAR BEAMS AFTER AN INITIAL AIR CURING OF 62 DAYS

The second series of mortar beams were kept in a moist chamber for the first 24 hours, left in air for 62 days, in water for seven days and then in air. The results of these tests are shown in Fig. 2. The beams containing the admixture in amounts greater than 2 per cent showed an increase in shrinkage over the plain beams. At the end of three days the increase in shrinkage over the plain beams was about 12 per cent; at the end of seven days about 15 per cent, and at the end of 28 days about 10 per cent. The beams which contained 1 per cent of admixture showed a decrease in shrinkage during the first 28 days.

Shrinkage Effect on Concrete—Two sets of 6x6x20-in. concrete beams, six beams in each set, were cast. In each set there were: Two beams of 1:1½:3 plain concrete, one of which contained 2 per cent admixture; two beams of 1:2:4 plain concrete, one of which contained 3 per cent admixture; and two beams of 1:3:6 plain concrete, one of which contained 5 per cent admixture.

The slump of all of the beams was kept constant at 4 in. In order to get this slump in the mixes which contained the admixture, a quantity of water equal to 200 per cent of the weight of the admixture was added. This changed the initial water-cement ratio as shown in Fig. 3, where the results of the test are shown.

In the 1:1½:3 beams and the 1:2:4 beams, the increase in shrinkage over the plain beams is not very great and occurs during the first five days. Beyond that period and up to the time the beams were covered with wet burlap, there is a slight decrease in shrinkage. During the period the beams were covered with the wet burlap there is also a slight decrease in shrinkage as compared with the plain beams. In the 1:2:4 mix there is a slight increase in shrinkage following the period during which the beams were covered with burlap. In the 1:3:6 beams there is a marked increase in shrinkage over the plain beams throughout the entire test period. This may be due to the increased amount of water which was added to produce the slump of 4 in.

Conclusions—(1) The shrinkage of 1:3 mortar is increased from 10 to 25 per cent when Celite is added in amounts greater than 2 per cent. (2) The shrinkage of 1:1½:3 and 1:2:4 concretes is not materially affected by the incorporation of 2 and 3 per cent of Celite respectively. (3) The shrinkage in 1:3:6 concrete is increased about 40 per cent when 5 per cent Celite is incorporated in the mix. It may be advisable to make provision for this increase in shrinkage when it is desired to use this quantity of Celite in the 1:3:6 mix in order to gain an increase in workability.

Sewage Chlorination Reported Successful at Bath, England

Sewage chlorination to control hydrogen sulphide odors, attributed to slow passage of sewage through an excessively large force main at Bath, England, is reported as successful by F. P. Sissons, city engineer (London *Surveyor*, July 13, 1928). "The force main," says Mr. Sissons, "is undoubtedly too large," so that it takes "many hours of ordinary pumping for the sewage to reach the works." Substitution of a smaller force main or lining the present one, it was concluded, would be prohibitive in capital cost. Apparatus was installed to apply liquid chlorine to the sewage before pumping. The maximum chlorine dosage has been 1.6 p.p.m., which "was effective in dealing with the dry-weather flow of sewage," which had occasioned some of the worst complaints. During wet winter weather the maximum dose was seldom used, and "when the river was in flood no chlorine was used at all, as it was found that the dilution, together with the increased pumping speed, was sufficient." Chlorine is delivered to the pumping station in 16-cwt. (1,792-lb.) steel drums. The cost of chlorine for a year is given at £600 ($2,940), but the amount of sewage treated is not given.

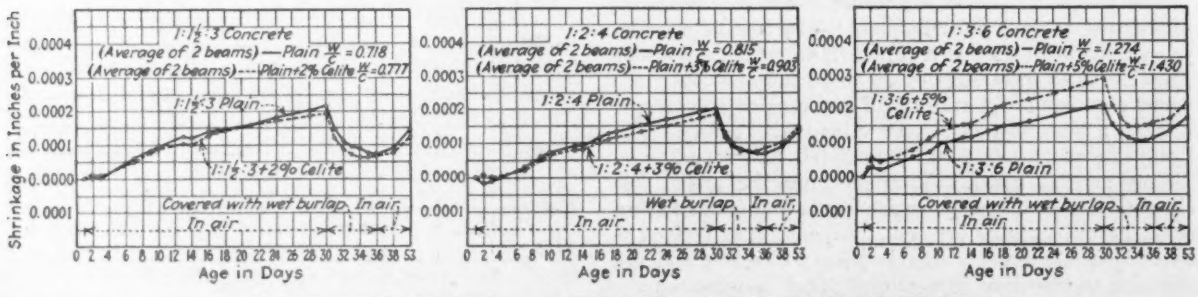


FIG. 3—SHRINKAGE EFFECT OF CELITE ON 6x6x20-IN. CONCRETE BEAMS

Shrinkage in the 1 : 1½ : 3 and the 1 : 2 : 4 concrete is not materially affected by addition of 2 and 3 per cent of admixture, while in the 1 : 3 : 6 concrete, 5 per cent admixture increases the shrinkage about 40 per cent.

Building a 375-Mile Pipe Line in 193 Calendar Days

Route Characteristics, Organization Plan, Engineering Features, Construction Methods and Corrosion-Hazard Studies for Natural Gas Pipe Line From the Texas Panhandle to Denver, Colo.

By Wm. Thompson Smith
Staff of Ford, Bacon & Davis, Inc., New York, N. Y.

Pipe Lines from 100 to 400 miles long are today common undertakings in developing the natural gas fields of Texas and Oklahoma. The rapidity with which these 16- to 22-in. mains are laid down in trench is one of the construction marvels of this decade of speedy construction operations. Contracts are being undertaken by trained pipe-line construction organizations which call for an average construction speed of 1½ to 2 miles a calendar day. And some of these contracts are being completed ahead of time. The operation described in this article is a notable example of modern natural gas pipe-line construction methods and performance. Both in size of pipe and in length of line it is remarkable. Again it is exceptional in the rugged and intractable country traversed. Yet the speed of laying down the line in trench, scores of miles of which were in solid rock, was almost 2 miles a calendar day. In just a little more than six months 375 miles of pipe line was completed and was delivering gas to consumers. How the task was accomplished is told in the article that follows. It deserves careful reading.—Editor.

THE Amarillo-Denver pipe line is the longest and the largest high-pressure gas line yet constructed. Only just over six months was required for the construction. Work was begun Dec. 13, 1927. On June 19, 1928, delivery of gas to the Colorado Fuel & Iron Company was commenced and on June 21 and 23 the line was put into operation supplying gas to Pueblo and Denver, respectively. In the 193 calendar days elapsed there was laid in trench, much of it in rock, an average of 1.96 miles a day of 16- to 22-in. steel pipe line. The engineering and construction features of the operation are noteworthy.

The new line furnishes gas from the Amarillo field in the Texas Panhandle to the cities of Denver and Pueblo, Colo.; to the steel plant of the Colorado Fuel & Iron Company at Minnequa, near Pueblo, and to a few small towns lying close to the right-of-way.

The Amarillo gas field as reported by geologists late in 1927 totaled 1,327,000 acres. There was at that time a total estimated gas reserve of 10,335,000 million cubic feet. The supply for the Amarillo-Denver line is obtained from 375,000 acres in practically a single block. There are now on this tract 30 wells with an aggregate open flow capacity of 750,000,000 cu.ft. per day. The area controlled and held in reserve is approximately 586 square miles and is believed to be the largest area of gas properties held in a single unit.

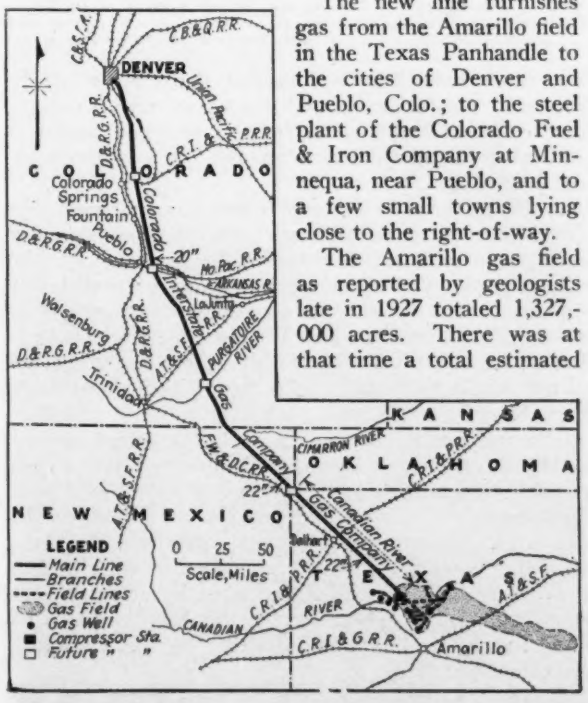


FIG. 1—GENERAL ROUTE MAP OF AMARILLO-DENVER NATURAL GAS LINE

The main line consists of 235 miles of 22-in. pipe and 105 miles of 20-in. pipe; the gathering and field lines aggregate 22 miles of 22-in. pipe; the branch to Pueblo consists of 11 miles of 16-in. pipe.

Description of Line—The Amarillo-Denver pipe line includes in the main line 235 miles of 22-in. and approximately 105 miles of 20-in. lap-welded, open-hearth steel pipe. In addition the gathering and field lines comprise 22 miles of 22-in. steel pipe and varying amounts of other sizes ranging from 4 in. to 20 in. The single branch of importance is approximately 11 miles long from the main line to the Colorado Fuel & Iron Company and the city of Pueblo; for this branch 16-in. pipe is used. Gate valves are provided at intervals of approximately 10 miles and provision is also made for the construction of branches to various points where a demand for natural gas may develop in the future.

While the line crosses several small streams which occasionally during wet seasons carry large volumes of water, the only ones requiring multiple lines as protection against possible interruptions in service are the Huerfano and the Arkansas rivers in Colorado. For these two crossings seven and six lines respectively of 10¾-in. pipe are used, all bowed upstream between headers located above normal high water to offer greater resistance to displacement by flood.

Except at river crossings, the line is plain-end steel pipe in lengths of about 20 ft. coupled with Dresser couplings using rubber gaskets. At the river crossings screw pipe is used with collar leak-clamps, and at each joint especially designed semi-steel river clamps weighing approximately ¼ ton each are bolted over the coupling and collar leak-clamp. These river clamps are machined on the inside to fit the pipe exactly.

The estimated ultimate capacity of the line is 100,000,000 cu.ft. per day. This capacitiy is to be reached through the operation of four compressor stations to be constructed as required at various points along the line. The present demand is satisfactorily cared for by the rock pressure alone, which is about 400 lb. per sq.in.

However, the engineers are now completing one booster station at a point 33 miles north of Amarillo where three 1,000-hp. units will be installed. At this station the engineers are also installing a gasoline absorption plant to receive the discharge from the compressors. The gasoline so produced is transported through a 2-in. welded steel line to storage tanks and filling racks at Amarillo.

Engineering Design Features

Due to the nature of the coupling used and the ultimate high pressure under which the line will be operated, it was considered necessary in all cases to insist upon a minimum depth of cover of 30 in. This minimum was maintained through rock sections, streambeds and steep slopes as well as in the more usual gently rolling prairie country. In most places the ditch depth was 56 in.

Alignment and Jointing—No angle in excess of 2 deg. in any direction was permitted. Accurate portable gages

FIG. 2—DEEP DITCH CUT IN ROCK
This cut is near the upper end of the ditch down the north side of Cimarron Canyon. Pipelaying down this steep slope is shown by Fig. 3.

were therefore a part of the standard equipment of each division engineer. Where sharper turns than are possible with 20-ft. lengths and the 2-deg. limitation were necessary, cut or "pup" joints of pipe were used. In extreme cases, to permit the maintenance of the minimum 30 in. of cover under streambeds, washes and arroyos, or to avoid too deep ditching at the tops of canyon walls, the contractors were permitted to use fire bends made in the field and slowly cooled.

Welded sections of line were installed under railroad and important highway crossings. These sections were made up by butt welding, the ends of the pipe having first been beveled, followed by the application at each weld of four equally spaced longitudinal straps of ½-in. material 4 in. wide and 18 in. long welded to the pipe the full length of each strap edge with the exception of that part immediately over the pipe weld itself. All such welds were annealed in the field by heating to a dull cherry red and cooling slowly.

In addition to being welded, crossings of railroad rights-of-way and all important highways were cased with 30-in. steel casing provided at each end with 2-in.

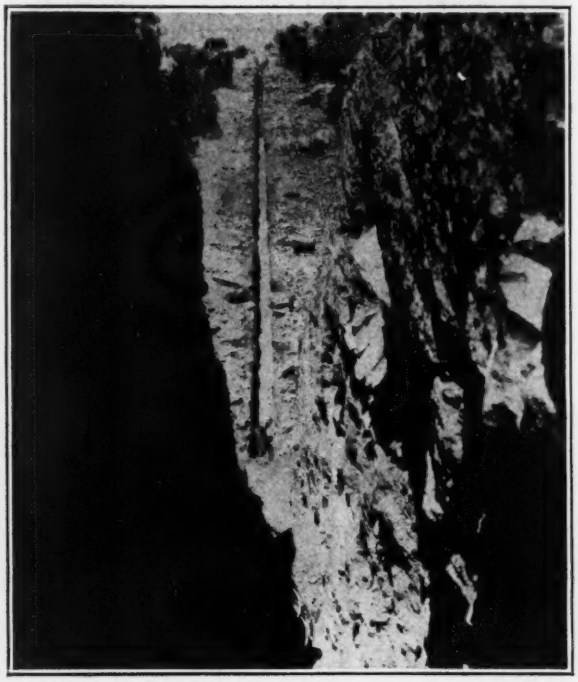


FIG. 3—LAYING PIPE DOWN NORTH SIDE OF CIMARRON CANYON
With a few lengths of anchor pipe at the bottom of the slope, the pipe is jointed length to length at the top of the canyon and pulled down the slope riding on the sleds shown by Fig. 4.

vent lines extending just beyond the surface of the ground. This construction, besides permitting, in the case of small leaks, escape of gas at points where it will cause no damage, makes possible quick repairs without tunneling.

Although many of the watercourses are normally perfectly dry, at times, although for short periods, they carry large volumes. It therefore becomes necessary to take apparently needless precautions to prevent future movement of the pipe. The usual practice of using concrete masses through which the pipe line passes was in large part discarded. The alkali waters and the alkali usually present in considerable quantities in local sands have been found to have very definite harmful effects on the permanence of concrete. Rather than incur the additional expense of avoiding alkali, even had this been possible, it was decided to use instead heavy iron castings specially designed and machined to fit over the couplings. Through watercourses, therefore, the usual weighting methods consisted of covering with broken rock where obtainable; the placing of heavy castings at each coupling, and occasionally the use, in place of broken rock, of cement sacks filled with a 1:1 mixture of cement and sand.

Corrosion Studies—In view of the extreme and unusual dryness of much of the territory traversed, it appeared possible that considerable expense for pipe protection might justifiably be avoided by investigating the

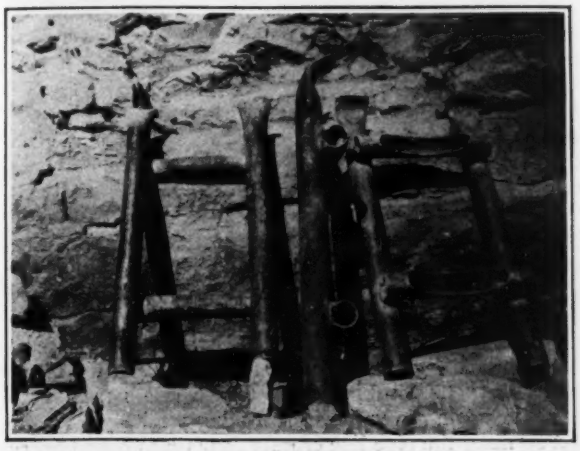


FIG. 4—SLEDS FOR MOVING PIPE DOWN SLOPES
A sled placed under each joint enabled line of pipe to be pulled down north side of Cimarron Canyon as shown by Fig. 3.

degree of corrosion to be expected at various points along the line. It is believed that there is no previous example of such a detailed attempt in connection with an actual construction project to estimate scientifically the degree of protection required for an underground pipe line.

Previous work along these lines has been based upon chemical analyses of soil samples taken at intervals along the right-of-way or in even more cases simply upon a consideration of various factors which may all be included under the heading of topography. This investigation insisted upon concurrent consideration of both chemical analyses and topographical conditions.

By means of a 2-in. soil auger soil samples were taken to a depth of 5 ft. at all points along the right-of-way where definite changes in topographical conditions were found. In no case, even in the absence of surface indications of probable change, were samples taken at distances greater than 1 mile apart. Subsequent to detailed analyses of these soil samples and of their water extracts by the firm of J. W. Richards & Son, chemists and assayists, of Denver, Colo., field inspections of topography covering the entire right-of-way were made by P. J. Richards, of the above-mentioned firm, and a representative of Ford, Bacon & Davis, Inc. These field trips noted accurately with respect to the location of survey stations such important surface conditions as slope, direction of exposure, apparent surface moisture, evidences of watercourses, lake beds and sinks, type of vegetation, use of ground and nature of soil. By interpretation of the analytical and topographical data so obtained, all sections of the right-of-way were rated comparatively with respect to their estimated corrosive effect upon steel pipe. These ratings were subsequently substantially checked, in the case of the worst ratings, by various laboratory methods suggested by the Cast Iron Pipe Research Association, the National Bureau of Standards and Dr. Engle, of the University of Denver, and, in the case of the best ratings, by the opinion of experienced pipelayers.

FIG. 5—HAND ROLLING METHOD OF ENAMELING PIPE
A 20-in. pipe with its ends carried on roller saddles is rotated by hand as the bituminastic enamel is poured on and spread by swabs.

FIG. 6—PIPE ENAMELING CREW IN ACTIVE OPERATION
Note pourers and swabbers working in pairs on pipe being rotated by device shown by Fig. 5.

Pipe Protection—Specifications were drawn calling for the application of heavy protective coating to 171.6 miles, or 50.5 per cent of the entire line, and of light protective coating to an additional 143.8 miles, or 42.3 per cent. It was considered justifiable as a result of the investigation mentioned to permit the laying of 24.6 miles, or 7.2 per cent, without protection of any kind. Subsequently a consideration of relative accessibility of various sections of the line for the purpose of quick repairs resulted in the reduction or elimination of coating at some of the more easily reached sections.

As finally laid, heavy protection consisting in general of a cold prime coat followed by the hot application of a coal-tar base enamel was used for 123.6 miles, or 36.3 per cent. Light protection consisting of application of coal-tar base coating brushed on cold was used for 97.6 miles, or 28.7 per cent.

Construction Methods and Organization

The general location of the pipe line is shown by the map. From an elevation above sea level of approximately 3,800 ft. at its start the line reaches its maximum elevation, approximately 7,000 ft. above sea level, east of Palmer Lake, Colorado. At only five points does it cross railroad rights-of-way. There are few crossings of important highways.

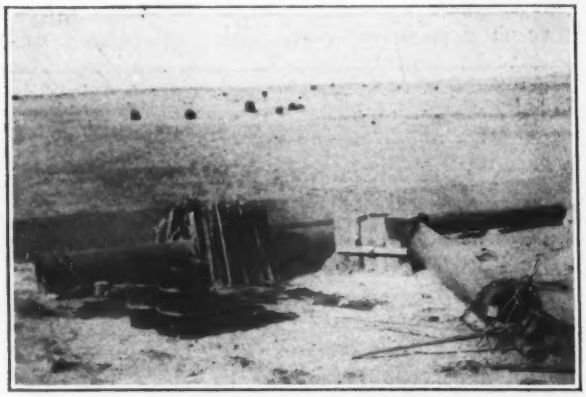


FIG. 7—PREPARATION FOR MAKING A FIRE BEND
These bends were used only occasionally where the specified curve limitations involved excessively deep cuts or other difficult requirements.

Route Conditions—Throughout Texas and the greater part of New Mexico, or for approximately 135 miles, the line runs through sandy soil and there are but few short stretches where rock prevented the use of ditching machines. In northern New Mexico and southern Colorado a rocky country of volcanic origin is traversed for a distance of 40 to 50 miles. In this section are located the most important of the canyons which are crossed, including Travesser Canyon, Cimarron and Long canyons and Purgatoire Canyon. The walls of these canyons vary from 400 to 700 ft. in height and have slopes as steep as 45 deg. The walls without exception are of rock.

Between canyons, particularly on the mesa top between Travesser and Cinarron canyons, there is practically continuous rock with little or no surface soil. The pipe-line ditch is cut to a depth of approximately 5 ft. in solid rock for a distance of 3¼ miles. The territory for some 30 miles between Long and Purgatoire canyons has slightly more surface soil and in places permits the use of ditching machines, even though the machines cannot always work to the full depth required. The northern 5 to 10 miles of this section is again practically continuous rock.

North of Purgatoire Canyon a gently rolling prairie country is traversed with only occasional outcroppings of rock. No obstacles in the way of fairly rapid progress were met in this section until reaching the crossings of the Apishapa and Huerfano rivers, approximately 30 miles south and east of Pueblo, and the Arkansas River crossing at Delvine, Colo. For some miles on both sides of the Arkansas River the pipe line passes through irrigated farming sections. Most of the irrigation ditches are normally dry during the season of the year in which the line was constructed. In a few cases a flow of water which could not be interrupted required the temporary installation of flumes. At all important ditch crossings concrete was freely used after laying the line to insure the maintenance of the desired course of the irrigation ditch and to prevent washouts of the pipe line.

North from the Arkansas River the right-of-way lies through a gently rolling prairie country. Approximately east of Palmer Lake it reaches its highest elevation above sea level at an altitude of approximately 7,000 ft. Here it passes through the heavily wooded Black Forest for a distance of 12 miles, where construction gangs cleared a 30-ft. right-of-way. Otherwise the crossing of the forest presented no difficulties other than those normally to be expected in a very sharply rolling territory. In the last 30 miles the pipe line crosses four times over Cherry Creek, normally a relatively small stream but occasionally swelled to flood stages by cloudbursts.

Unloading and Hauling—Approximately 2,000 carloads of pipe was required. Each carload contained from 36 to 54 20-ft. lengths of plain-end steel pipe. In all 139 carloads of couplings and nineteen carloads of coupling bolts were received. There were several carloads of pipe coating. Although the pipe line roughly parallels the main lines of the Denver & Rio Grande and of the Fort Worth & Denver City railroads, the delivery of materials was by no means a simple problem.

In addition to the difficulties involved in handling within a limited period the large quantities of materials distributed among some 25 unloading points, the infrequency of roads and trails between unloading points and right-of-way necessitated careful study to determine the best distribution of materials among unloading points considered from the standpoint of length of haul and nature of available roads. Numerous factors, including the sparseness of population, the presence of canyons, arroyos, rivers, etc., and the general aridity of the country, necessitated in many cases the adoption of roundabout roads, with the result that the truck haul in some instances was as great as 40 miles.

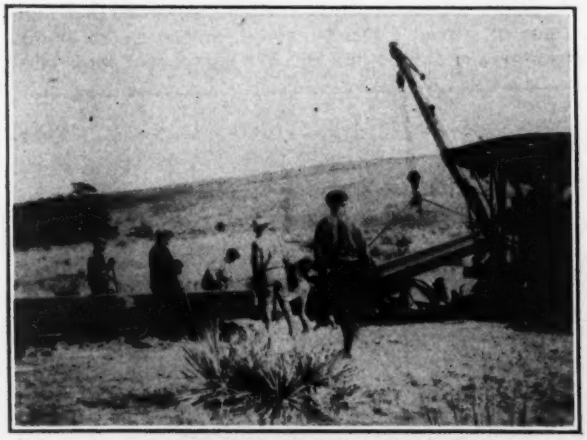


FIG. 8—CRANE STABBING A 20-IN. PIPE INTO COUPLING
The pipe was connected up in long sections on skids spanning the trench as shown by Fig. 9.

Practically all material with the exception of pipe was unloaded by hand at receiving points where temporary storeyards were created along the available sidetracks. The pipe was unloaded by gin poles, or A-frames, and

FIG. 9—PIPE ON SKIDS READY FOR LOWERING
The lowering was done in long sections using pipe horses operated by hand. This is a 22-in. pipe in the earth section south of the Apishapa River.

block and tackle, the motive power being 2-ton trucks; 25 trucks were used. A gang of seven men with a gin pole and a 2-ton truck could unload approximately ten cars of pipe in a day.

Materials of various kinds were distributed as required from the temporary storeyards by 3-ton trucks. Trailers were used in stringing the pipe, the usual load being seven lengths of pipe, or approximately 5¼ tons. All trucks used in stringing material had oversize pneumatic tires to avoid damage to road surfaces and to permit the maximum safe speed. This latter consideration was extremely important on account of the average length of haul and the economic inadvisability of using too much equipment at the receiving points of less volume.

Equipment and Labor—Wherever possible all work was done mechanically. The use of trucks to unload and string materials has already been commented on. Wherever machine ditching was possible ditching machines were used. In open country these ditching machines working 24 hours a day could easily cut per day 1 mile of ditch 5 ft. deep and 26 in. wide. On account of the general aridity of the country, the absence of moisture in the soil was so complete that although work continued throughout the winter, it no case did frozen ground offer any obstacle nor in fact was it possible to note any frost line.

Pipe cranes were used for stabbing the pipe and later for removing skids. The pipe was laid by hand with the use of from five to seven pipe horses. Practically all backfilling was done with backfilling machines.

The use of mechanical equipment even extended in large part to the application of pipe protection. While much of the cold coating used was applied by roofing brushes or the well-known canvas sling method, practically all hot coating was applied by hand-operated or motor-driven rolling rigs developed and controlled by the Wailes Dove-Hermiston Corporation. The use of these rigs in place of the more common canvas sling unquestionably resulted in important savings of materials and provided a more uniform coating with less experienced crews and permitted more thorough inspection.

Wherever possible, local labor and supplies were utilized. No more than skeleton organizations of foremen and sub-foremen, pipe stabbers and such skilled labor were imported by the contractors. The maximum number of laborers employed was 2,000.

Special Pipelaying Methods—At the crossings of the Huerfano and Arkansas rivers, screw lines of 10¾-in. pipe were used. The Huerfano River, during the period of construction, was almost entirely dry. The lines in this case were, therefore, completed on the surface of the ground and subsequently sunk to position by hand labor. At the Arkansas River, however, the stream was perhaps 150 ft. across with a maximum depth of from 3 to 4 ft. In this case the lines were laid on the flat bottom land immediately south of the stream and the river clamps were attached, after which the lines were pulled across by cable. In this case no ditching in the riverbed was possible, but it was found that the weight of the line itself was sufficient to dig during its passage a trench of a depth approximately equal to the pipe diameter. Such a trench together with the river clamps was considered sufficient to insure the permanency of the lines.

Laying the main line in the walls of the Travesser, Purgatoire and Cimarron canyons, on account of the steep slope and unusual height, offered some obstacles. Such obstacles were increased by the great distances by the shortest roads between top and bottom of the slope, which ranged from 20 to 40 miles. At the first of these walls, the north wall of Long Canyon, after the ditch was completed and graded an anchor section of four 20-ft. lengths of pipe was laid at the bottom of the main slope. Subsequently the line was laid from the top, joint by joint, and pulled down the slope by cables attached to the topmost joint. In its descent the line moved on sleds constructed of 2-in. pipe fitted to the contour of the pipe and wired to each coupling. At the Purgatoire Canyon the line was laid joint by joint from the bottom up, each joint being snubbed down the hill in the pipe ditch. At the south wall of Cimarron Canyon a third method was used involving the transportation of materials and pipe on small dollies moving on wooden tracks.

Gate Setting and Line Testing—Although gate valves are now installed at approximately 10-mile intervals throughout the length of the line, the gates were not placed until the completion of the pipelaying. This pro-

FIG. 10—ROLLING COUNTRY DITCH LINE
Topography and trench in ascent north from Cimarron Canyon. With Figs. 2, 3 and 9 this view indicates all kinds of ditch work encountered.

cedure permitted more rapid progress of the pipelaying gangs without interruption by the more specialized work of setting gates. It also made possible the utilization of more experienced labor continually for this single important phase of the work.

The required gates were set successively, starting at the field or south end of the line. Prior to the cutting of the line at any point for the installation of a gate the next preceding section was packed with gas at the highest available rock pressure. After cutting the line, packed gas was used to blow out the next section before setting the gate valve. This method prevented damage to gates and seats of the valves during the process of removing dirt and various foreign bodies from the line and gave at least preliminary indications of gas tightness.

Organization—The Amarillo-Denver pipe line was constructed for the Canadian River Gas Company and

FIG. 11—MULTIPLE LINE CROSSING OF HUERFANO RIVER
Six lines of 10-in. pipe in skids ready to be lowered into trench. Note the lines bowed upstream and with heavy anchor couplings to resist displacement by flood.

the Colorado Interstate Gas Company by Ford, Bacon & Davis, Inc., which established offices at Colorado Springs, Colo., and at Amarillo, Tex., for this purpose and for its subsequent operation of the line. All work was directly supervised by E. G. Hill, vice-president. The engineers of the gas companies constructed the compressor station, the gasoline absorption plant and the multiple-line river crossings and all meter and regulating stations with their own forces.

For the main line bids were received from eight contractors for stringing materials, ditching, painting, laying and backfilling. The contract for the southern 86.3 miles was awarded to the Oklahoma Contracting Company of Dallas, Tex. Williams Brothers, Inc., of Tulsa, Okla., was given the contract for the remainder of the line to Denver, Colo. Subsequent additional contracts for the field and gathering lines and for the branch line to Dalhart, Tex., were awarded to the Oklahoma Contracting Company and for the 2-in. gasoline line and Clayton and Pueblo branch lines to Williams Brothers, Inc. The stringing of materials along the right-of-way from a number of convenient railroad points was handled in the case of the Oklahoma Contracting Company by its own organization and in the case of Williams Brothers, Inc., through a subcontract awarded to Tibbetts & Tibbetts, of Olathe, Kan.

Matters pertaining to the construction of the compressor station and gasoline plant were handled by Ford, Bacon & Davis, Inc., through its Amarillo office. For its part of the work the Oklahoma Contracting Company established a field office at Dalhart, Tex. Williams Brothers, Inc., maintained a general office at Colorado Springs, Colo., and various temporary divisional offices, warehouses, repair shops, garages, etc., at many points along its section of the right-of-way.

All supervision and inspection of pipelaying and protection were under the immediate direction of engineers of the Colorado Springs office of Ford, Bacon & Davis, Inc. Reporting to these men were four division engineers, each resident in and in direct charge of the work in one of the four divisions into which the entire project was divided. Each division engineer had a staff of inspectors sufficient to permit at least three inspectors to each of the contractor's gangs working within his division.

To complete the project in so short a time it was of course necessary to carry on operations at a number of different points. The various starting points were so spaced that all gangs might complete their work simultaneously. In general, construction camps were avoided, as local labor was largely used. The Oklahoma Contracting Company, however, did operate one camp and at various times Williams Brothers, Inc., operated camps at three locations.

The Oklahoma Contracting Company with 85 miles of work used only one construction gang. The organization, however, of Williams Brothers, Inc., with 155 miles of work was similar to that of the engineers. Its Colorado office exercised general supervision. Division superintendents, each one operating in a specified section, had charge of the construction foremen of the gangs operating in their respective sections.

For both Ford, Bacon & Davis, Inc., and for Williams Brothers, Inc., the plan of organization called for daily reports from the field forces. Similar reports were forwarded to the Colorado Springs office of Ford, Bacon & Davis, Inc., by the Oklahoma Contracting Company.

Timber Bridge Construction Saves State Money on Nebraska Highways

The use of creosoted timber instead of steel and concrete in bridges on Nebraska highways has resulted in a saving of $375,000 to the state during the last four years, according to R. L. Cochran, state engineer. In an article on "The Nebraska Highway Program" he says in part:

"While our bridge construction is mainly of steel and concrete, we have during the past few years used creosoted timber to a considerable extent where conditions were favorable to this type of construction. The total number of creosoted timber bridges built during the past four years amounts to 93, with a total length of 6,236 ft., or approximately 1¼ miles. A conservative estimate of the saving effected by using creosoted timber instead of steel and concrete in the cases above cited is approximately $375,000, or sufficient money to gravel more than 150 miles of highway."

Steel Frame Office Building 564 Ft. High

A credit line omitted from the article on the Greater Penobscot Building, at Detroit, in *Engineering News-Record* of Sept. 20, p. 424, should have stated that this article was by W. S. Wolfe, chief structural engineer for Smith, Hinchman & Grylls, of Detroit, Mich., architects and engineers for the building.

Florida Storm Damage Confined Largely to Poorly Built Structures

Survey of Conditions at Palm Beach and West Palm Beach Show Slight Damage to Well-Constructed Buildings—Kind of Construction Rather Than Materials Important

By R. S. Tilden
Engineer, Common Brick Manufacturers Association, New York City

To Amplify his telegraphic report which was published in our news pages last week, R. S. Tilden has sent the following report of the character of the damage at Palm Beach and West Palm Beach during the hurricane of last month. His report is confined to damage to structures in and around the coast cities. He does not attempt to report upon conditions around Lake Okeechobee. —Editor.

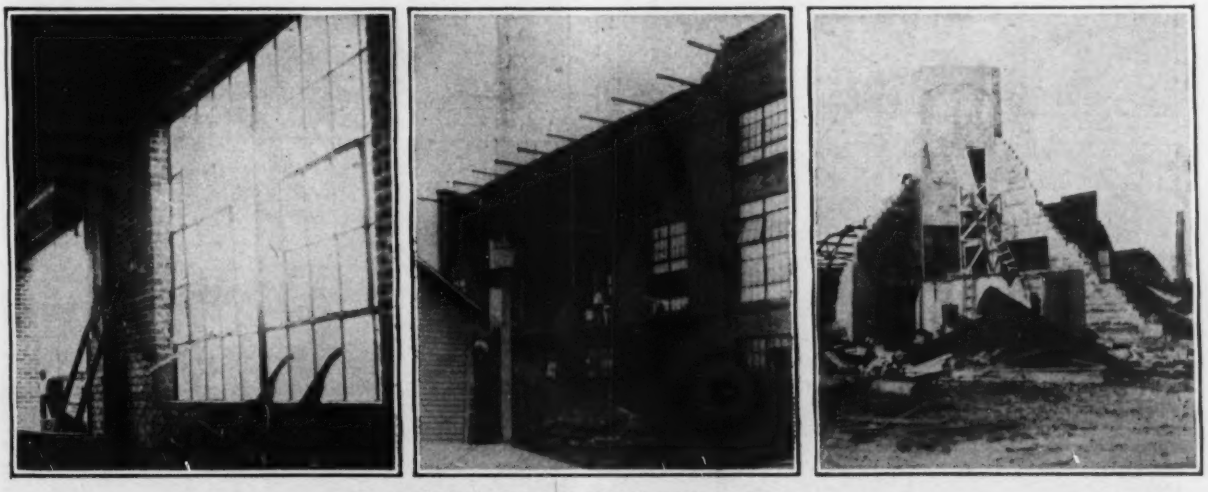
THE recent Florida hurricane which struck the Palm Beaches on Sept. 16 was, in the words of A. J. Mitchell, in charge of the Weather Bureau station at Jacksonville, "quite as severe as that at Miami two years ago." While no official observer is located at West Palm Beach, unofficial barometric readings by L. O. Williams, chemist, and K. R. Chinn, assistant superintendent of water-works, included the following: Sept. 16, 2 a.m., 29.49; gradually decreasing to 29 at 3 p.m., 28 at 6 p.m., 27.57 at 6:18 p.m., 27.74 at 6:30 p.m.; gradually rising to 28.86 at midnight, and to 29.20 at 8 a.m. on Sept. 17. Mr. Mitchell says, "This record is not improbable," but repeats that the lowest official reading ever recorded for the United States was 27.61 at Miami during the 1926 storm. Wind velocities cannot be definitely ascertained, but a conservative estimate places it at about 100 m.p.h. Some idea of wind velocity may be gained from the fact that in one case a piece of roofing tile striking sheet lead flashing approximately $\frac{1}{8}$ in. thick passed through the lead.

The storm followed an irregular course, passing east of Miami, through the Palm Beaches, to the northeast of Tampa and west of Jacksonville, with lessened velocity. Roughly speaking, the area of greatest damage extended about 25 miles north of West Palm Beach and an equal distance south, but extended west into the Everglades to the eastern shores of Lake Okeechobee. The path of the storm center is well marked, as trees and poles which failed in the first wind lie in one direction, while those blown down by the wind following the storm center lie in the opposite direction.

Railway communication was cut off entirely. The Florida East Coast Railway suffered little damage to roadbed or structures and partial service was restored practically as soon as the roadbed was cleared of débris. Train operation was seriously delayed, however, by the destruction of the pole lines carrying the wires of the signal system, and it was not until a temporary cable had been laid and connected that this road was able to anticipate a resumption of normal service. The Seaboard Air Line roadbed was damaged to a greater extent and in consequence was somewhat slower in the restoration of its train service.

Electrical current for this section is furnished by the Florida Light & Power Company. Normally it is brought in over transmission lines, but the storm broke these lines north of Jupiter, about 25 miles north of West Palm Beach, and in the vicinity of Delray, an equal distance to the south. An emergency plant, however, is maintained in West Palm Beach and it is from this plant that current is being supplied.

Service to the water-works was restored on the afternoon of the 17th and 30 per cent of the normal load was being carried by the 18th, included in which were the

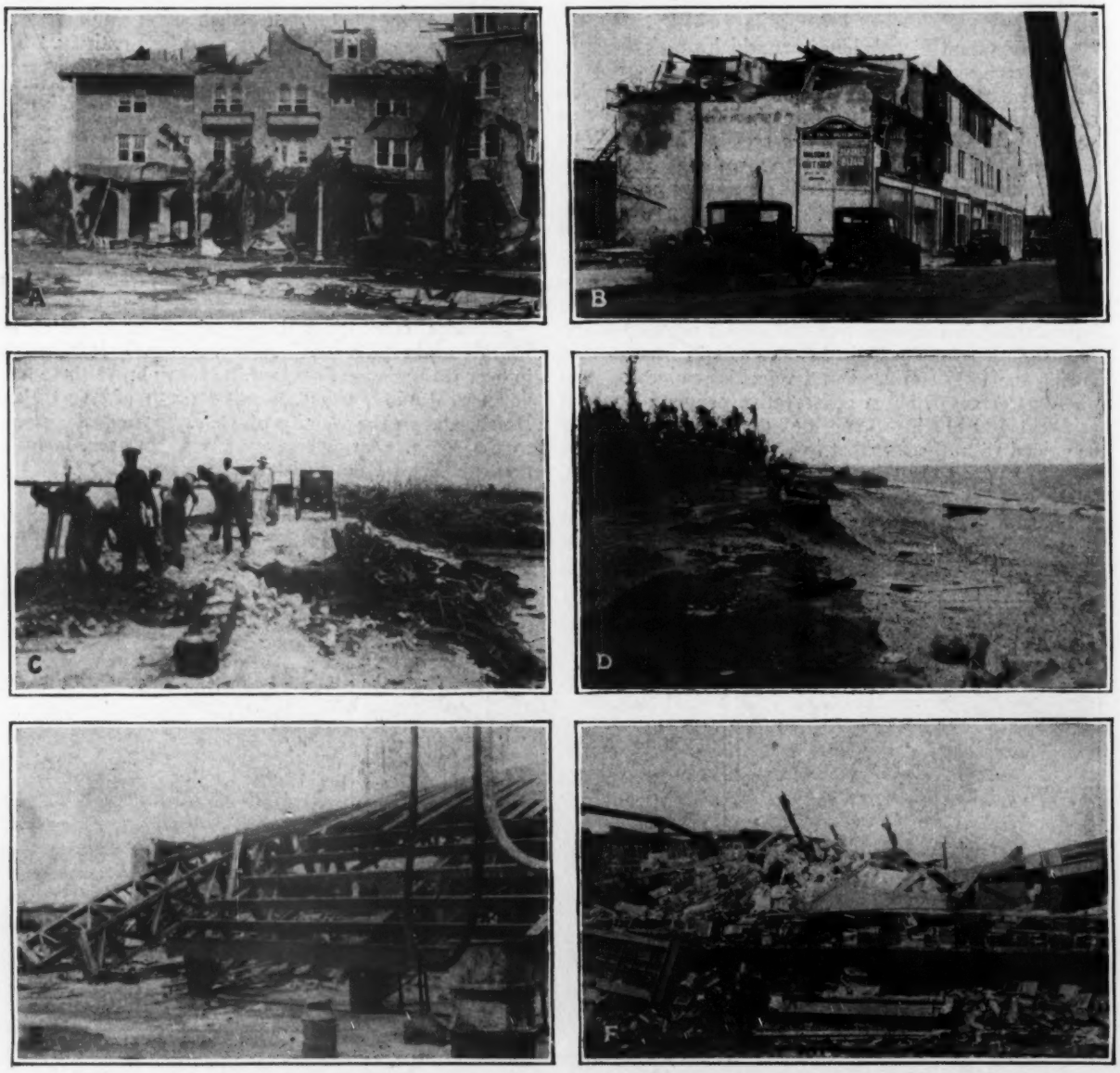


DAMAGE TO INDUSTRIAL BUILDINGS

Left: Windows of Southern Bell Telephone Building with steel frames bowed inward by wind pressure. Center: Wall of Florida Light & Power Building blown out as result of failure of steel sash on windward side of building. Right: Complete wreck of Delray laundry, a concrete block building.

hospitals and other relief or emergency plants, hotels, etc. By the morning of the 22d this had increased to 40 per cent and current was available for a greater load had the wiring within buildings been in condition to use it. In smaller centers where it was impossible to restore lines quickly, gasoline pumps were furnished to waterworks and other steps were taken to provide for the urgent necessities. This company, in common with most of the public utilities, made as complete advance preparation as possible. As an illustration, on Saturday, the day previous to the storm, radio messages were sent to New Orleans, Boston and other points for both personnel and material, both of which were promptly dispatched. Linemen coming into the district arrived with complete equipment and, due to the uniformity of the construction standards of these companies, men were actually engaged in restoring service within less than one hour after reaching their destination.

Telephone service to points outside of West Palm Beach was paralyzed due to the destruction of the lines. The switchboard in the headquarters building, which normally operates upon an outside supply of current, has a storage battery reserve of about twelve hours and so might have continued operation. It was realized, however, that immediately upon cessation of the storm there would be great demand from hospitals and other relief agencies, so the switchboard was closed down to conserve the battery reserve. Calls for service from the Red Cross, hospitals, etc., were taken care of promptly. One line to Jacksonville was connected by 5 p.m. on the 18th, and although this later failed, by 10 p.m. two lines were operating to that city. Each of these was capable of carrying four messages simultaneously. This company also had ordered out emergency help before the arrival of the storm, and crews from Georgia, Alabama, Louisiana and Tennessee were actually en route to West Palm Beach before the storm struck. The headquarters building sheltered the local personnel as well as many refugees, and from 75 to 100 persons were given first aid by the company employees for injuries incidental to the storm.



CHARACTERISTIC DAMAGE FROM FLORIDA HURRICANE

A—South wing of Miramar Hotel, frame and stucco construction. *B*—Condemned Lake Park Hotel, frame construction veneered. *C*—Typical damage to Belleglade-Pahokee highway. *D*—Ocean Boulevard at Palm Beach. *E*—Roof of warehouse No. 1, Gulf Refining Company. *F*—Warehouse of Palm Beach Paper Company.

Telegraphic service, as all other lines of wire communication, was cut off. Immediately upon the abatement of the storm motorcycles were dispatched to Miami at hourly intervals and messages were put on the wires at that city. Special trains carrying linemen, operators and material were made up and sent out from various points, but railway conditions delayed their prompt arrival. By 6 p.m. on the 19th messages began to go out of West Palm Beach and, as all classes of employees had been increased to about ten times the usual number, by the 21st all messages were being transmitted promptly.

Public utility concerns generally made as complete advance preparations as possible, and had it not been for flood conditions in other states delaying the trains carrying their emergency crews and material shipments the excellent work of these companies would probably have been bettered. Provision was made for housing and feeding employees and everything possible was done to restore service promptly.

Pole line failures showed little uniformity. In some cases poles snapped off at varying heights above the ground, while in others the saturated soil permitted the poles to blow over without breaking. Wire breakage was also irregular, all wires being broken at some points and few at others.

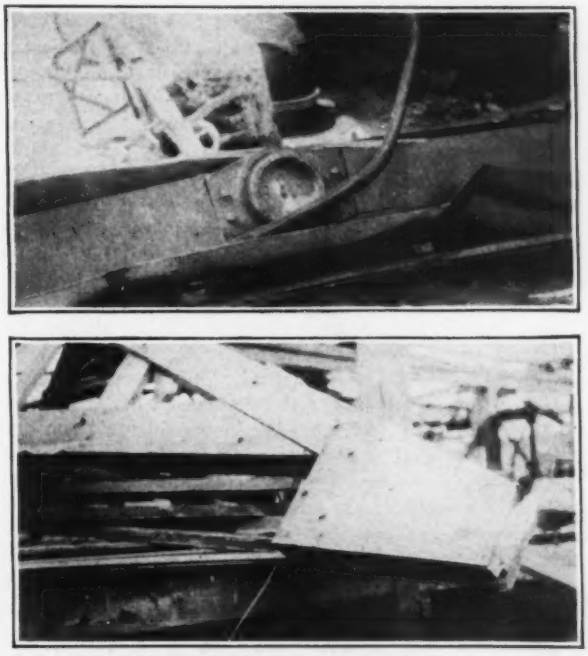
Water mains crossing Lake Worth from West Palm Beach to Palm Beach with one exception were carried by the several bridges and all so carried were broken. The exception was a new 24-in. line about 6 ft. below the lake bed, and it was this line which permitted service to Palm Beach. Washouts on Ocean Boulevard, Palm Beach, caused serious breaks in the mains at these points. While the mains in West Palm Beach were not damaged to any considerable extent, some idea of the damage to the system as a whole may be gained by the following:

Date	M. G. Per Day	Pressure in Main
Sept. 17, p.m.	22	18
Sept. 18, p.m.	11	60
Sept. 22, a.m.	5 (or under)	60

This also indicates the rapidity with which the temporary repairs were made. By the afternoon of the 22d all mains were full and the supply was ample. Lake Worth City, adjoining West Palm Beach on the south, was not so fortunate and as late as the 25th notices were still posted asking the public to conserve water and forbidding all fires, except for cooking purposes, without permission from the Fire Department.

With the exception of the Everglades and the boulevard along the ocean, highways suffered little damage. Most washouts were of minor importance and the few large ones were promptly repaired. Ocean Boulevard, however, had many serious washouts and the beach at certain points washed out to a depth of approximately 6 ft. In the Everglades roads show little damage until a point about 20 miles west of the city is reached. At this point Conners highway is under water and in such condition that it has been closed. For a while this was the road over which all the relief traffic passed and was the line of communication to Lake Okeechobee. The road via Six Mile Bend to Belleglade is under water for some 5 miles and is beginning to show serious indications of damage. The road from Belleglade to Pahokee is seriously damaged by washouts, and in places it has been necessary to lay planking over the emergency repair fill. The shoulders of this road have been eaten away to such an extent that at many points it is impossible for vehicles to pass each other.

The bridges from West Palm Beach, Lake Worth City and other points to the east are damaged in varying degree. The one carrying the Florida East Coast tracks to the hotel properties required little repair and was in use on the 17th. The Royal Palm bridge, a reinforced-concrete structure, sustained serious damage to the west abutment and approaches. This has been temporarily repaired and is in service. Two other bridges to the south were seriously damaged as to decking and the approaches. The approach from Palm Beach to one of these is washed out for about 200 yd. Both have the draws lifted.



CONSTRUCTION DETAILS SHOWING ENTIRE LACK OF ANCHORAGE

Above: Cap of pipe column supporting overhang of Gulf Refining Company Building. Below: An unanchored roof truss.

In West Palm Beach the city dock, of reinforced concrete, is completely destroyed and the dock house is seriously damaged. The pier of the Palm Beach Yacht Club has some pile bents remaining, but little else. Another dock (Kennedy's) lost practically all decking and much of the pile capping.

A part of the public market, consisting of two sheds supported on wooden posts, the roof carried by wooden framed trusses, sustained considerable damage. In one section some of the trusses with their supporting columns were blown down and a considerable part of the roof, including sheathing, has blown off. In the other section the damage is confined to the roof, part being entirely gone, while in an adjoining area the roof surface of diamond asbestos shingles is missing, the structure being otherwise unhurt. The incinerator plant, at the southerly end of the city, consisted of one building with brick walls and steel framed roof with a cement tile—the usual chimney and a shed of steel framing inclosed with heavy wire mesh on a concrete foundation. The chimney is undamaged and the brick building is in good condition except for broken glass and some damage to the roofing. The shed collapsed, damaging the foundation at points where columns were anchored.

The County Court House, a four-story brick building with stone trim, was practically unhurt except for some broken glass, and the Southern Bell Telephone head-

quarters, a four-story steel frame building with brick inclosure walls, in the words of T. L. Jordon, district manager, "is intact." The warehouse of this company also was undamaged except as to steel sash and glass. The steel sash, as shown in an accompanying illustration, actually bent before the glass failed.

To this same cause is laid the failure of one wall of the emergency plant of the Florida Light & Power Company, one of the few instances of serious damage to well-built structures employing reliable materials. Mr. Matson, the chief engineer of this company, described this building as having an "explosion-type" wall. The frame is steel, but contrary to usual building design, the columns stand free rather than inclosed in the wall. Part of one wall, unsupported by buttresses, beams or columns throughout its length of about 100 ft., blew out, and Mr. Matson definitely placed the blame upon the failure of several steel sash openings in the front of the building. There are several instances of steel sash failure in West Palm Beach and it would seem that sash sections for use in districts subject to high wind velocities should be increased or redesigned to secure additional strength. Fire Department headquarters, a two-story brick building, suffered practically no damage except in the belfry.

The larger office buildings of steel or reinforced-concrete frames as a class came through very well, with the exception of glass breakage and minor items. Smaller commercial buildings did not fare so well. The warehouse of the Palm Beach Paper Company, a two-story hollow-tile building with wooden floor construction, is practically a total loss. It is significant that hollow tile as used in West Palm Beach and vicinity does not have the thicker web and shell of what is commonly termed "load-bearing" tile, but the thinner section (approximately ½ in.) of partition block. It is probable that this fact, together with poor quality mortars and insufficient anchorage, two points which will be mentioned later, accounts for the great number of failures of this material.

The warehouse of the Southern Storage Company, a new building of concrete block, is a complete loss, as the illustration shows. An interesting contrast is evidenced by two buildings of the Dade Lumber Company. One, of brick, is in excellent condition, while the other, of hollow tile, is badly damaged.

Palm Beach proper also presents a contrast illustrative of the difference in the ability of two types of building to withstand storm. The properties in this case are two of the Florida East Coast hotels, the Breakers and the Royal Poinciana. The Breakers, a reinforced-concrete structure, suffered little if any structural damage, with the exception of the roof of the two east wings. These wings are of fireproof construction up to the ceiling of the uppermost bedroom floors, above which was a pitched roof of frame construction with a tile surface. Many of the frame trusses are still standing, but with this exception the roof is a total wreck. Plaster throughout the building, with the exceptions later noted, withstood the storm very well, which was probably due to the fact that the floor slabs were of fairly watertight gravel concrete and that an unusual system of plastering was employed. In the case of the ceilings this consisted of coating the concrete slab with a neat cement wash and applying a thin brown coat to this wash before it had thoroughly set, the white coat being placed over the brown in the usual manner, the total thickness of the plaster not exceeding probably ¼ in. The exceptions mentioned were where hung ceilings were used for architectural effect. These were the usual three-coat plaster on metal lath and were very seriously damaged by water. It is probable that repairs to the Breakers, excluding damage to contents and chimney, can be made for $150,000.

The condition in regard to the Royal Poinciana is more serious. This hotel consists primarily of three sections. The original building, known as the Flagler section, is of heavy frame construction supported upon brick foundations which extend up to about the ceiling of the first floor. This section suffered very little damage. The first addition, consisting of a long wing running north and south and in which the first floor was built of frame instead of brick, is very seriously damaged. This addition is bowed out toward the west to an extent probably approximating 3 ft. in places, in spite of the fact that the timber construction is of the mortise-and-tenon type and of much greater dimensions than are usually used in frame buildings, although not sufficiently large to be classed as mill construction. The second addition, which runs east and west at the northerly end of the first addition and is built in a similar manner, is also very seriously damaged. The first floor is at least 2 ft. out of plumb and the upper stories a somewhat less amount. Wind entering this wing exerted such pressure that a portion of the roof structure on the west end was completely blown off. Both of these wings are very badly racked with heavy plaster damage and it will probably be impossible to repair either of them. The service quarters, also a frame building, is seriously out of plumb and racked to such an extent that it is doubtful if it can be made serviceable.

Another hotel property seriously damaged is the Miramar at West Palm Beach. This building, of frame and stucco, is in very bad condition. Practically the entire roof and a considerable portion of one story was blown off, some of the wooden wall sections falling on the opposite side of the street. While it is impossible at this writing to make a definite statement, it is probable

STORM'S EFFECTS ON DIFFERENT TYPES OF BUILDINGS
Above: Episcopal church of frame and stucco with concrete buttresses. Below: Southern Storage warehouse of concrete blocks with wooden roof framing.

that the remaining parts are so racked and out of plumb that reconstruction will not be practicable. Among the older hotels, the Lake Park, a frame and veneer building, is in such condition that its demolition has been ordered.

The condition of two churches, under construction, is of interest. The Payne A.M.E. Church, of reinforced-concrete frame with brick inclosing walls, is only slightly damaged. Roof trusses (no roof on) fell and scaffolding was blown down, but only one small panel of brickwork in the main tower is not serviceable. The brickwork inclosing the large circular window in the front wall still stands, although the masonry circle rises several feet above the adjoining wall. The Tabernacle Baptist Church, nearer completion, is more seriously damaged. This church, of hollow tile with brick facing, lost a considerable portion of the front wall. While the tile in this case, as in those previously mentioned, is of the partition type, a more careful supervision of mortar ingredients and mixing and, equally important, thorough bonding of brick facing and tile wall would have added considerably to the quality of the masonry and might have brought this church through with only minor damage.

Two of the older churches also tell a story. The Episcopal church, a frame and stucco building with heavy buttresses of poured concrete, is almost a total wreck, as the illustration shows, while the old Methodist Episcopal church, of brick with stone trim, had a small amount of roof damage and an entrance door broken. This latter church sheltered a large number of refugees and, like the court house, telephone company building and large office buildings, was one of the places where large numbers gathered seeking safety at the start of the hurricane.

One plant deserving of special mention was that of the Gulf Refining Company. This consisted of what I shall call warehouses 1 and 2, office building and tanks. Warehouse 1 had brick walls, a roof supported by curved trusses as shown, built up of wood with a bottom chord of a round rod about $\frac{3}{4}$ in. in diameter. No. 2 was of similar design, but a roof overhang was carried on a girder supported by pipe columns. The office building was one story brick, with pitched roof. Horizontal tanks were ten in number on the customary brick supporting walls, and in addition there was a larger vertical tank. All brick walls were 12 in. thick. The roofs of both warehouses moved to the south under the wind pressure and in so doing broke the top of the brick walls so that both of these buildings show heavy loss. A field inspection discloses that the mortar strength is exceedingly variable, much of the mortar being easily broken between the fingers, and that no provision whatever was made for anchoring roof structures to the masonry. The ends of the trusses which still show the detail of construction indicate no bolts or other method of fastening roof and wall together, and a glance at the illustration of pipe column cap shows clearly that weight of the roof structure was depended upon to prevent lifting motion. From the present condition of the trusses it is probable that they were of sufficient strength and that neglect to provide anchorage is directly responsible for destruction of these buildings.

In the district adjacent to the railroad, where many of the warehouses are situated, the damage is extremely heavy. The buildings, of concrete block or frame covered with corrugated metal, are in many cases a complete loss and almost all are seriously damaged.

The poorer residential district also suffered heavily, where construction is largely of frame for houses and concrete block for stores. Both types generally failed. In the better class residential district most buildings are damaged to a considerable extent, but the building destruction is not as great as in the warehouse and poorer residential sections.

The action of roofing during this storm is of more than ordinary importance for two reasons—the damage done to glass and building exteriors by flying tile and the general failure of roofing, permitting the entrance of the rain and consequent large loss by water damage to building contents. Probably the most popular material is a Spanish type of tile. Next in popularity are asphalt shingles and roll roofing; wooden shingles come next, and some asbestos shingles, including hexagonal, are used. Tile roofs were extensively damaged, and the people of West Palm Beach blame that material, through broken windows and damaged roofs, for much of water damage. Personal inspection confirms this belief. In addition to window breakage and roof punctures caused by flying tile, many building exteriors were damaged and in some cases building walls, of stucco over frame, were punctured by tile pieces. Asphalt shingles and roll roofings naturally could not stand up once the wind worked under even a small section of surface, and the casualty list in roofings of this class is heavy. Wooden shingles, while experiencing considerable damage, probably enjoy the best record of all roofing materials in this district, but due to the fire hazard involved their continued use is subject to a continually increasing legislative prohibition. Asbestos shingles, considering their lesser popularity in the district, had high mortality, probably due to their brittleness. As an example, the gymnasium of the Lake Worth High School, built this year and roofed with asbestos shingle, lost a considerable portion of roof surface. In this instance most of the shingles broke on a line paralleling the nail holes and blew off, leaving the nails in place.

The lesson of the Florida hurricane of 1928 is the same as that of the one of 1926 and of all similar disasters, and can be expressed in few words: Well-designed structures, honestly built of reliable materials, have again demonstrated their trustworthiness; skimped design and shoddy construction, either as to quality of materials or workmanship, resulted in enormous loss.

This condition is recognized by E. L. Biggerstaff, building superintendent of West Palm Beach, who expressed himself recently as heartily in favor of more stringent building regulation to the end that the city might be saved a recurrence of the recent disaster. Mr. Biggerstaff cited instances where an exception to the building code had been made, thereby permitting substandard construction, and remarked that in every case which came to mind the sub-standard job has been practically demolished. It is probable that the governments of the various communities in the affected district will, under plea of temporary necessity, permit the erection of buildings increasing the normal hazards of fire, wind and water, and if so we may expect with full confidence a repetition of the present disaster when another hurricane blows through the district. We may also expect the same economic loss to the community and a repetition of the financial ruin of many families caused, not by Providence, but by the unwillingness of man to seek and use the judgment of competent advisers. It is the duty of the engineering and construction professions to work ceaselessly to protect the thoughtless or uninformed against a catastrophe similar to that enacted on Sept. 16, 1928, in Palm Beach County, Florida.

News of the Week

Civil Engineers Board Acts to Increase Work of Technical Divisions

Research Work to Be Put on Much Broader Basis—Anson Marston Nominated for President

IMPROVEMENT and development of society work were considered by the board of direction of the American Society of Civil Engineers, in session at San Diego, Oct. 1 and 2, just preceding the quarterly meeting of the society. The board approved plans for more active prosecution of research on a broadened basis, took a significant step toward placing more responsibility on the technical divisions and local sections by discontinuing the monthly meetings at New York, directed that a study of the working of registration laws and their lack of co-ordination be carried out, gave favorable consideration to proposals that the programs for quarterly meetings be worked out in co-operation with near-by local sections and considered a rearranged administrative system which will give equal place to professional and technical activities.

In furtherance of research the board's committee on technical expansion recommended that three classes of research be provided for: first, investigations of practical questions mainly by the technical divisions; second, studies of special problems by committees of divisions or society, and third, research on larger projects requiring extensive funds and organization to be carried on by the society alone or jointly with interested outside agencies. Suitable administrative procedure was outlined. These recommendations were approved by the board.

Fuller report was asked on recommendations that non-technical or professional activities be placed on equal footing with technical work in the society system and program, and that the character of regional meetings be improved by enlisting aid of local sections in formulating programs and arrangements.

Abandonment of the monthly meetings conducted by the society at New York was accomplished by a resolution that a business meeting shall be held March and October but providing that special meetings for reading and discussing papers may be arranged by the board.

Departing from the rule of holding a single annual meeting of the local sections' conference, an informal conference was held Oct. 2 with nearly every Western section represented. A lively discussion of programs, meetings, committees and publications developed in which the Spokane, Sacramento, Denver, Los Angeles, Salt Lake and Texas sections were prominent.

The constitution of the American Standards Association, which will replace the American Engineering Standards Committee, was approved. Reports of three A.E.S.C. projects relative to symbols of which the society is joint sponsor were approved.

Anson Marston, of Iowa State College, was nominated for president. Prizes for papers are to be awarded Charles E. Sudler, Roderick B. Young, James F. Case, Roy G. Finch and Franklin Hudson, Jr., with no award of the Rowland prize.

Toronto Gets 1929 Convention of the A.W.W.A.

The 1929 convention of the American Water Works Association will be held in Toronto, Ont., the week beginning June 24. Decision to this effect was reached by officials of the A.W.W.A. while in attendance at the Montreal convention of the N.E.W.W.A. Sept. 18-21. That gathering was also seized as the occasion for what proved to be protracted meetings of committees of the A.W.W.A. dealing with the plan and scope of the new general committee which is to take the place of the old Standardization Council; also of the committee on a new constitution. Rumors of proposed radical amendments to the A.W.W.A. construction were circulated in Montreal, but nothing official has yet been given out.

Burgess to Be Governor of Canal Zone

Col. Harry Burgess, Corps of Engineers, U. S. Army, has been appointed Governor of the Canal Zone to succeed Brig. Gen. Meriweather L. Walker, whose term expires Oct. 15. Colonel Burgess is engineer of maintenance of the Canal Zone at the present time.

Colonel Burgess was born in Starkeville, Miss., in 1872 and was graduated from the U. S. Military Academy in the class of 1895. Upon graduation he served for three years at the Engineers' school and on harbor and fortification work. During the Spanish-American War he was on submarine mine duty and in 1900 went to the Philippine Islands for a year's duty during the insurrection. Upon his return to the United States he was in charge of river improvement work at Louisville, Ky., and then district engineer at New Orleans. During the World War Colonel Burgess commanded the 16th Engineers (Railway) during the whole period of its service in France.

A.G.C. Heads Discuss Problems Affecting Construction Industry

General Manager and Committees Make Reports—Nominees for Office Announced

SOME 60 members of the Associated General Contractors, including the executive board, the advisory board, the president's council and the secretary's council, met in fall meeting at Minneapolis, Minn., Sept. 24-26. In addition to routine business, the nomination of officers and progress reports of standing committee and staff operations, there was active discussion on credit practices in time payments, accident prevention work, prequalification of contractors, day-labor construction on the Mississippi flood-protection works, affiliated bureaus and organization finances. In some of these special activities distinct progress was recorded.

Officers and Finances

Except for director in district 1, where six candidates were named, each by the same number of votes, the letter ballots from zones and districts showed a positive majority of nominating votes for one candidate. These candidates for vice-presidential zones 2, 4 and 5 were H. H. Wilson, R. L. Gode and J. T. Haile. Of the six district directors to be voted on the majority candidates are William V. McMenimen for districts 2 and 3, D. A. Daly in district 10, Herman Brown in districts 12 and 13, Henry J. Kaiser in districts 14 and 15 and William F. Feigenson in district 16. For president the nominating committee named T. E. Flagler and for vice-president at large H. S. Tullock.

Speaking on finances, General Manager D. A. Garber announced that the preparation was in hand of a new plan of financing the association which would relieve the handicap now put on him and the official staff by non-payment of dues and difficulties of collection. More than a quarter of this year's dues, he stated, were now in arrears and to keep this year's budget from showing a deficit they must be collected. This he and the staff felt they could do, but it meant turning a force which was paid for constructive work into a collection agency. This he did not purpose to continue and unless an adequate way of financing the association's operations was worked out and put into effect he did not care for and would not continue in the position of general manager. The new financing plan will be presented for consideration at the annual convention to be held in February.

With the association's work on credits,

bonding, equipment standardization and other questions involving other construction agencies than contractors there has come about a need for authority to associate with the A.G.C. these agencies as affiliated bureaus. Something of this nature has already been carried out in the case of the mixer manufacturers and in the case of certain groups of equipment distributors. The time, it was considered, had now arrived to take up seriously this affiliation work and a definite plan of action was being provided in a new draft of association bylaws and rules of procedure for presentation at the annual convention. Meanwhile several arrangements for affiliated bureaus were in hand and membership authority was required to put in the course of quick adoption the new bylaw governing the work. The bylaw, which is of some length, was read, and on resolution the members voted that the general manager be authorized to put it through the regular course of action for official adoption.

Progress in Accident Prevention

Continuation of the work begun two years ago under a special staff manager to advance safety practices in construction was reported. In the line of educational effort addresses of safety have been made in 34 cities on both coasts and throughout the country to stimulate the interest of contractors in accident prevention. In addition, contact has been established with some twenty state industrial commissions to acquaint them with A.G.C. efforts and make friends for the industry. An accident prevention manual has been published and 4,000 copies have been distributed. A set of warning signs has been prepared and 4,600 have been bought and used on their work by contractors. In all, 896 firms and individuals are working on accident prevention and are reporting to the association. Of these firms and individual contractors 521 have entered the cup contests.

Among the activities of the year have been conferences with the American Engineering Standards Committee regarding its work of creating a code of safe construction practices. The developments from these conferences have been discussed in *Engineering News-Record*, Aug. 2, 1928, p. 155; Aug. 10, 1928, p. 210, and Sept. 20, 1928, p. 446. Briefly, the A.G.C. management announced at Minneapolis its objection to any form of mandatory code and its disinclination to enter into joint sponsorship with governmental labor officials of the code work of the Engineering Standards Committee.

Correcting False Credit Conditions

During the year conferences have been held with various groups of equipment manufacturers and distributors to work out a plan for stabilizing credit practices in time payment sales. As the result of these conferences and of a questionnaire answered by more than 75 manufacturers, a schedule of credit terms was prepared for the consideration of manufacturers. This schedule required, with the exception of dredges, that the cash down payments should be at least one-third of the price. The period of deferred payment was varied for different classes of equipment as follows:

Group	Time, Months
No. 1—Mixers and pavers	4
No. 2—Shovels, cranes, ditchers, draglines, trenchers, dredges, diggers and excavators, rollers, tractors and crushers	9
No. 3—Batchers, bins, batch boxes, industrial railway equipment, road and paving forms, storage tanks, truck tanks, truck bodies, finishing machines, oil distributors, and oil burning equipment	3
No. 4—Buckets (clamshell, dipper, orange peel and dragline), drag scrapers	3
No. 5—Bucket elevators, conveyors, elevators, leaders, sand and gravel washers, revolving screens, shaker screens, and truck loaders	3
No. 6—Back fillers, crawlers, graders, elevating graders, subgraders, iron mules, scarifiers, spreaders	3
No. 7—Derricks—hoisting equipment, cableway equipment	4
No. 8—Compressors, air tools	3
No. 9—Power units, pumps	3
No. 10—Saw rigs (gas and electric) electric, tools, all kinds	2

These terms are now being submitted to manufacturers. So far the response has been encouraging. Group 2 has, however, replied with a counter schedule which calls for a down payment of 20 per cent and deferred payments extending over fifteen months. This was set down in the report as being unsatisfactory to A.G.C. management.

Prequalification of Bidders

During the year conferences have been held with the Bureau of Public Roads and the highway departments of California, Washington, New York, Utah, Wyoming, Colorado, Iowa, Wisconsin, Illinois, Ohio, Pennsylvania, Indiana, Oklahoma, Delaware, Maryland, Virginia, North Carolina, Florida and Texas. Briefs have been submitted to the city engineers of New York State, American Association of State Highway Officials, city of Philadelphia, American Society for Municipal Improvements, city of St. Louis, Interdepartmental Board of Contracts and Adjustments, Comptroller General of the United States, Corps of Engineers, Treasury Department, Navy Department. The subject is being pushed with all federal agencies. Legal decisions on responsibility and functions of awarding officials have been compiled and sent to 50 federal bureaus, 48 state highway departments and on request to about 40 municipalities. More than 300 requests for this compilation were filled. Also a tentative act has been drafted and is now in course of study by individual contractors, engineers, surety officials and others. About 30 state highway departments and two federal bureaus are now qualifying bidders. Some of the states and these two federal bureaus are qualifying before issuing plans.

Date Set for Kentucky Water Power Hearing

Nov. 14 has been selected as the tentative date for the public hearing which the Federal Power Commission will hold on the application of the Cumberland Hydro-Electric Power Company for a license for a proposed project at Cumberland Falls, Ky. The hearing will be held in Chicago.

George C. Schoenberger Dies

George Christian Schoenberger, chief state engineer of Louisiana and well-known expert on Mississippi River problems, died Sept. 24 in New Orleans, La., of acute indigestion. He was 58 years old. Mr. Schoenberger had spent his entire life in river-control work in the vicinity of New Orleans, and during the flood of 1927 was in charge of the dynamiting of the Poydras levee below that city. He was a member of the American Society of Civil Engineers.

MOVING 150-FT. PLATE GIRDERS FOR MOUNT HOPE BRIDGE

Transporting eight of the longest plate girders ever fabricated through the streets of Bristol, R. I., was accomplished by using a pair of trailers pulled and pushed by trucks. The girders, two of them 150 ft. long and six 140 ft. long, were used in the Bristol approach of the Mount Hope suspension bridge connecting Bristol and Portsmouth. Arriving in pairs requiring four flat cars each, the girders were reloaded onto the trailers by locomotive and crawler cranes. Two heavy trucks pulling and one pushing the trailers were required for the 2½-mile trip from the railroad yards to the bridge site. At the site a special double A-frame derrick lifted the steel off the trailers. The girders were moved by the Callan Construction Company, of Bristol, subcontractor on the masonry work on the Bristol approach, in conjunction with the Rogers Trailer Company.

Ralph H. Howard, Chief Engineer of Wabash Railway, Dies

Ralph H. Howard, of St. Louis, Mo., chief engineer of the Wabash Railway, died at Petoskey, Mich., following a stroke of paralysis suffered on Aug. 28 while on his vacation. Mr. Howard was born on Aug. 15, 1870, in Zanesville, Ohio, where he received his early training. In 1890, he entered the service of the C. & M. V. R.R., now a part of the Pennsylvania Railroad, as assistant in the engineering corps. In 1902 he was advanced to the position of assistant engineer, maintenance of way, St. Louis Division, which he held for three years. In April, 1905, he went to the Chicago & Eastern Illinois Railroad as principal assistant engineer in charge of construction and in October of the same year he became chief engineer. After five years in that office he became associated with the New Orleans & Great Northern Railroad as general manager. In 1915 he went to the Wabash Railway as chief engineer, maintenance of way, and in 1923 was promoted to chief engineer of the Wabash system.

Strauss, St. Louis

Ralph H. Howard

Mr. Howard was a member of the American Society of Civil Engineers and the American Railway Engineering Association.

Irrigation Hearing Postponed

The public hearing on the proposed construction of an irrigation dam on the Gila River above the new Coolidge dam, which was scheduled to be held in Washington Sept. 20, will be held Oct. 9 in Safford, Ariz. It is expected that Secretary Roy O. West of the Department of the Interior, who is now on a trip through the West, will attend.

Engineer's Bill for $612,435 Settled for $45,000

The suit of George A. Johnson, consulting engineer, New York City, against the North Jersey District Water Supply Commission for $612,435 for services and damages in connection with his engagement and its discontinuance as engineer for the Wanaque aqueduct, assigned to Thomas McNulty, of Jersey City, has been settled out of court for $45,000, according to an announcement to the commission made on Sept. 27 by John A. Matthews, assistant counsel. Mr. Johnson, after a report recommending changes in the aqueduct plans, was put in charge of the work by a resolution of the commission adopted May 5, 1927, and released by a vote taken Aug. 5 following. He claimed $250,000 for work done and $390,000 damages for breach of contract and had been paid $27,565.

Commission Reports Findings on U. S. Paving Conditions

Present System Wasteful Due to Poor Supervision—Trend Toward Higher Types

AN ENGINEERING commission appointed by the National Paving Brick Manufacturers' Association early in 1928 to investigate paving and general highway conditions throughout the country and on the relation of vitrified brick pavement to traffic (as announced in *Engineering News-Record* of March 8, 1928, p. 422) has just issued an extended report. The commission is composed of William H. Connell, chairman, formerly engineering executive of the Pennsylvania State Highway Department; Warren R. Neel, state highway engineer of Georgia; Perry J. Freeman, chief engineer of the Bureau of Specifications and Tests of Allegheny County, Department of Public Works, Pittsburgh; and Frederick J. Cellarius, consulting engineer and former city engineer, Dayton, Ohio. Its principal findings concern the present status of highway conditions, the extent of losses from inefficiency in highway construction, the economics of pavement selection and the service value and proper manner of use of vitrified brick. Some of the main points of the report are outlined in the following notes.

General Highway Conditions—About $2,000,000,000 a year is spent on highways in the United States. Of this sum it is estimated that at least $400,000,000 is wasted through incompetent supervision. Lack of control over construction is put down as the outstanding cause of poor pavement, and this weakness will never be corrected until highway work is divorced from politics. The commission states that "this is a problem for the highway users to solve."

"In many localities the politicians limit the engineering control to what may be termed window dressing—that is, the engineers control everything but the supervision of the construction. Their control over the construction is through unqualified inspectors who are forced upon them."

Other causes of poor pavement are inadequate foundation and lack of proper provision to remedy poor subsoil conditions, which are engineering problems.

Maintenance on the state highway systems is declared to be of a high standard, and the pavements are kept in good condition. The average maintenance of county roads is only fair; in the boroughs and townships poor. Maintenance in some cities is very good, in many others poor.

Present Trends—A considerable increase in higher-type construction is to be expected, particularly on rural highways, due to the constantly increasing traffic. It is becoming generally realized that the only consideration first cost should receive in determining upon the selection of pavements is to supply a basic figure from which to determine the annual costs. Where the pavement is to be subjected to any appreciable amount of traffic comprising heavy loads high-first-cost standard pavements will show the least annual cost over a period of years.

Vitrified Brick—A modern vitrified brick pavement is an economical pavement for medium and heavy traffic, in the opinion of the commission. Brick has shown high resistance to heavy rubber-tired traffic in tests by the U.S. Bureau of Public Roads, the Illinois Highway Department and others. The vital importance of an adequate foundation is emphasized in the report.

Many vitrified brick pavements have carried traffic from 20 to 40 years with little maintenance cost and are in good condition today. Numerous brick pavements from 20 to nearly 40 years old were rebuilt, using about 80 per cent of the old bricks in the new pavement. Vitrified brick pavements constructed with adequate foundation, a thin sand cushion and an asphalt filler have given satisfactory service for fifteen years with practically no maintenance cost and are still good for a long period.

The full report will soon be published in book form by the National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Death Claims Two Well-Known Retired Army Officers

In the short space of three days two well-known army engineers on the retired list have passed away. Brig.-Gen. William H. Bixby, former Chief of United States Army Engineers and an expert on Mississippi flood control, died at Washington on Sept. 29. On Sept. 26 Col. Frederick Vaughan Abbot, chief of the division of operations in the office of the Chief of Engineers during the war, died at his summer home at Nonquitt, Mass.

General Bixby, a graduate of West Point, during his 50-year career in the army took part in nearly every important engineering undertaking of that service. He was noted particularly for his knowledge of bridges, rivers and harbors. From 1908 to 1910 he was president of the Mississippi River Commission, and was made Chief of Engineers in 1910. In 1912 he had charge of the removal of the wreck of the "Maine" from Havana harbor. He was retired on Aug. 11, 1913, at his own request, in order that his lifelong friend, Colonel Russell, might be appointed Chief of Engineers before reaching retirement age. During the World War General Bixby was called back to duty, being placed in charge of river and harbor improvements of the Kansas City district. He was a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the British Institution of Civil Engineers, the French Society of Civil Engineers, and several other societies. In 1912 he was president of the Philadelphia Congress of the International Association of Navigation Congresses and in 1917

he was elected president of the American Society for Testing Materials.

During the World War Colonel Abbot took an active part in the training of engineer troops for overseas service. He also served as commanding officer of Washington Barracks, District of Columbia, as commandant of the Engineers' School, and was several times acting Chief of Engineers. As a result of his services, he received the distinguished service medal. During his career Colonel Abbot served as member of the New York Harbor Line Board and the Board of Engineers for Rivers and Harbors.

Water System at Oakland, Calif., Bought by Municipal District

Announcement was made on Sept. 26 that properties of the East Bay Water Company, which supplies Oakland, Calif., had been acquired by the East Bay Municipal Utility District for $34,660,000. Negotiations for this purchase have been under way for several years, but heretofore it has not been possible to agree on price. Meanwhile, the utility district, which includes nine cities on the east side of San Francisco Bay, has been developing a new source of water supply on the Mokelumne River. Last year a bond issue was approved by the voters with which the district was authorized to purchase or construct a distribution system.

The serious damage of the Lafayette dam by subsidence during construction, reported in last week's issue, is believed to have hastened negotiations for the purchase of the properties. The purchase acquires the entire holdings of the water company, including all lands (about 42,000 acres), reservoirs, pipe lines (1,391 miles), pumping plants, etc. In the transfer of ownership the district is to pay $13,960,000 in cash and assume the mortgages, bonded indebtedness, etc., totaling $20,700,000.

Latest Action in Wanaque Aqueduct Controversy

Fuller & McClintock to Take Over Engineering Work—Report From Metcalf & Eddy Not Yet Public

EMPLOYMENT of Fuller & McClintock, New York City, as engineers for completing the design and supervising the construction of the Wanaque aqueduct has been decided on by the North Jersey District Water Supply Commission. This action again takes the work out of the hands of Arthur H. Pratt, chief engineer of the commission, the first instance having occurred more than a year ago, when the aqueduct work was intrusted to George A. Johnson, New York City, only to be returned to Mr. Pratt later on. Mr. Pratt remains as chief engineer and Morris R. Sherrerd as consulting engineer to the commission.

The aqueduct as now planned will be on the same line and grade as provided in the latest Pratt and Sherrerd plans, but, except as noted below, will take advantage of the full head of the reservoir, instead of picking up the water after its discharge through an aerator just below the reservoir. The aerator will be built but will be used only when deemed necessary, water being lifted to it then by a pumping plant which is to be added to the Pratt and Sherrerd plans. Approaches to the two tunnels, completed some years ago, will be reinforced to carry the increased head due to the added pressure now contemplated.

Supplementary contracts between the district and the eight municipalities concerned, required because the commission must have largely increased funds to complete the project, have been approved by some of the cities and towns and are the subject of ordinances pending in the others. Three municipalities, Montclair, Bloomfield and Glen Ridge, employed Metcalf & Eddy, Boston, to advise them as to the changes recommended by Mr. Fuller in a report to Paterson, Passaic and Clifton. The Metcalf & Eddy report has not yet been made public, but it is known that the deferred action by these towns has resulted in a material scaling down of their allocated shares of cost under the supplemental contract, on the ground that the increased capital costs for pumping plant and other changes are of more benefit to some of the other communities than to them—a matter not gone into in the Fuller report mentioned above.

For the history of the Wanaque aqueduct controversy see *Engineering News-Record*, May 5, 1927, p. 746; May 19, 1927, pp. 827, 832; June 2, 1927, p. 916; June 9, 1927, pp. 931, 959; June 23, 1927, p. 1035; June 30, 1927, pp. 1045, 1062, 1075; July 7, 1927, p. 30; July 14, 1927, p. 75; Aug. 11, 1927, p. 239; Aug. 18, 1927, pp. 249, 251, 274, 280; April 26, 1928, p. 678; May 3, 1928, p. 711; May 10, 1928, p. 757.

Alberta Railway Lines Bought by Canadian Pacific

The provincial government of Alberta has announced the completion of the negotiations for the sale of the provincial railways to the Canadian Pacific Railway at a price of $25,000,000. This cost includes the payment of first mortgage bonds of the Edmonton, Dunvegan & British Columbia Railway, amounting to $9,420,000, and the payment of $15,580,000 spread over a period of ten years. The other roads affected by the transfer are the Central Canada and the Alberta & Great Waterways. The Canadian Pacific assumes the cost of extensions now in progress, which will probably amount to about $1,000,000. The agreement is subject to ratification by the dominion parliament, the provincial legislature and the shareholders of the railways concerned.

$1,000,000 GRADE CROSSING ELIMINATION PROJECT COMPLETED AT GIRARD, OHIO

Grade crossings over five railroads have been eliminated by this concrete viaduct across the Mahoning River Valley, connecting Girard and McDonald, Ohio. The main structure is 2,100 ft. long, has a maximum height of 85 ft. and includes a 200-ft. arch span across the river. A 30-ft. roadway and two 5-ft. sidewalks are provided. The total cost of the structure was $1,046,000, not including the expense of changes necessary on the railroad tracks. The viaduct is of reinforced concrete except the spans over the railroads, the latter being of structural steel incased with concrete. Foundations of the main span are carried to shale rock, the rest being based on concrete piles. The roadway is paved with bituminous concrete except for the steeper grades of the approaches, which are of vitrified hillside brick. Approach grades reach a maximum of 12 per cent. The cost of the elimination was distributed among Trumbull County, the townships of Weathersfield and Liberty and the railroads concerned. The Wendell P. Brown Company, Cleveland, Ohio, was in charge of engineering and design.

Chicago Opens Largest Activated-Sludge Plant in World

With the opening of the new North Side sewage-works on Oct. 3, Chicago has put in service the largest activated-sludge plant ever built. This plant, built as part of the extensive system of the Sanitary District of Chicago, comprises preliminary settling tanks, aerating tanks and final settling tanks. Sludge will be pumped 18 miles to Imhoff tanks at the West Side sewage-works. The North Side works are designed to serve a population of 830,000 in 1930, with an average sewage flow of 175 m.g.d. A description of the plant, by E. J. Kelly, chief engineer of the Sanitary District, was published in *Engineering News-Record* of March 11, 1926, p. 394, and further particulars of the completed works will be given in a later issue.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Porto Rico Storm Records—Mississippi Methods—Water Rate Savings May Be Extended

A PRELIMINARY report received by the Weather Bureau from Oliver L. Fassig, in charge of the San Juan (Porto Rico) station, shows that the officials on duty during the hurricane did everything humanly possible to obtain an accurate record of what happened. Roofing strips were blown from the instrument building and the whole structure threatened to collapse at any moment. A near-by balloon shed was demolished and its roof was carried 150 ft. Weather Bureau personnel were out at the storm's height helping refugees to safety. Yet they got complete records except for wind velocity, which could not be accurately observed during three hours due to the anemometer being damaged. As soon as a slight lull permitted, one of the men climbed the 50-ft. tower and installed another instrument.

The anemometer failed at an indicated wind velocity of 144 m.p.h. when one of the cups and connecting cross-arms blew away. Dr. Fassig states the storm increased in intensity for three hours thereafter. He estimates the maximum at 160 m.p.h. It may be possible to check this figure from an "as is" rating of the instrument applied to records after the damage.

While hurricanes are not quite so violent as tornadoes, it is hardly conceivable that a revolving cup device could stand up under the terrific impact of wind-carried débris, it is stated. The instrument in question was of the three-cup type improved from the Robinson four-cup to give a straight-line relation between actual velocity and that of the buckets. The base rating is from wind tunnel experiments at the Bureau of Standards with velocities up to 113 m.p.h. determined from pressure at an orifice in the tunnel wall. Indicated tunnel velocities were obtained by pitometer readings and found accurate within negligible error by tests with balloons balanced to the weight of air. It has been established that an anemometer built on standard specifications will conform to the base table without separate rating. As far as may be ascertained, no anemometer has been tested to destruction inasmuch as hurricane conditions could not be duplicated in the laboratory due to the indeterminate effect of gusts and débris. Many of those familiar with design of these instruments are satisfied that the type now in use meets all reasonable requirements. A wind meter on the Venturi principle, which can be applied to localities where there is any likelihood of exceptional winds, is being developed.

Hydraulic Levee Construction

A reduction in the cost of levee work and the speeding up of the whole flood-control program is seen at the Corps of Engineers as a result of the successful use of hydraulic dredges on the lower Mississippi River. A method has been devised which prevents the soil from draining back with the water. The hydraulic process will make it possible to build better levees, it is stated, as the water imparts compactness to the soil going into the structure. Moreover, roots, stumps and other objectionable material cannot be pumped into levees, it is pointed out.

Dirt is now flying on the flood-control project from New Orleans to Cape Girardeau. Prices of land have been secured from all owners along two alternative routes for the Bonnet Carré spillway, 30 miles above New Orleans.

Demands are being made along the proposed floodways in Louisiana that the government make actual purchase of the land between the protection levees along the diversion channel. With this done, it is believed that the federal engineers would recommend that there be no fuse-plug levee at the head of the Boeuf Basin. If there is to be any lowering of the height at which the fuse plug begins to operate, the engineers apparently are of the opinion that there be no levee at all and that conditions be restored similar to those previous to the leveeing off of Cypress Creek.

Water-Rail Transportation

With the avowed purpose of giving every state in the Union the benefit of the lower freight rates which apply on the barge lines, the Inland Waterways Corporation has made formal application to the Interstate Commerce Commission, under the Denison act, for a certificate of convenience and necessity for the establishment of joint rates and through routes to apply on practically every railroad in the United States. In the opinion of the Secretary of War, the granting of this petition "will be, beyond question, the greatest individual advance in carrying out the policy of Congress to promote and co-ordinate rail and water transportation."

Engineering Societies

CALENDAR

Annual Meetings

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; annual convention, Toronto, Canada, Oct. 8-9.

AMERICAN WELDING SOCIETY, New York, N. Y.; fall meeting, Philadelphia, Pa., Oct. 8-12.

SOUTHWEST WATER WORKS ASSOCIATION, Fort Worth, Tex.; annual convention, Dallas, Tex., Oct. 15-18.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York, N. Y.; annual convention, Chicago, Ill., Oct. 15-19.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; annual convention, Detroit, Mich., Oct. 22-28.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago, Ill.; annual convention, Boston, Mass., Oct. 23-25.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York, N. Y.; annual convention, Biloxi-Gulfport, Miss., Nov. 13-17.

The Colorado Society of Engineers held a luncheon meeting Sept. 18 at which George R. Day, of the Denver Planning Commission, spoke on "Denver Needs the Engineer."

The Fourth Annual Meeting of the Missouri Conference on Water Purification will be held at Hannibal, Mo., Nov. 14-17. Water purification, deep and shallow water supplies and sewage treatment are topics for consideration on the program.

The National Builders Supply Association and the Southern Builders Supply Association will hold a joint meeting at Memphis, Tenn., Dec. 5-8. An exposition of building material, which will be open to the public at certain hours, will be held in connection with the convention.

Obituary

Theodore Charles Roberts, consulting engineer, died on Sept. 28 in New York City at the age of 52. A great deal of Mr. Roberts' work was done in the mining field, as he was associated for years with the Guggenheim interests in Colorado. He was also chief engineer for H. M. Byllesby & Company, and was later associated with the W. A. Clark interests in Arizona. He was a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, and the American Institute of Electrical Engineers.

John R. Rablin, chief engineer of the Metropolitan District Commission, Boston, Mass., died on Sept. 17. He was 60 years old and had been with the commission 30 years. As chief engineer Mr. Rablin had control of the construction of all roads and bridges in the Boston metropolitan district.

Construction Equipment and Materials

Road Show to Open Jan. 14

The convention and road show of the American Road Builders' Association will be held in Cleveland, Ohio, Jan. 14-18, 1929. The convention will hear a number of especially prepared papers on different phases of road and street construction and maintenance, as well as reports from a number of committees, including a committee on grade crossings, another on depreciation of roadbuilding equipment and a third which has been investigating the laws controlling the practice of liens as they affect public work. The road show will be made up of approximately 500 carloads of roadbuilding machinery and material. Additional area has been provided which will be completely filled with the products of members of the manufacturers' division of the association.

New Developments

New Steel Roof Deck Combines Ease of Design and Erection

A new steel roof deck has been developed by the R. C. Mahon Company, Detroit, which is claimed to simplify roof design greatly and to hold unequaled opportunities for ease of erection. All erection work is done from the upper side of the roof. Each roof deck unit consists of one standard roof plate and three standard clips by which the plates are fastened together and to the supporting framework. No tool other than the ordinary hammer is required for erection purposes. In the accompanying illustration a cross-section of a roof deck installation is shown, as well as an intermediate clip used to lock the roof deck plates together mid-

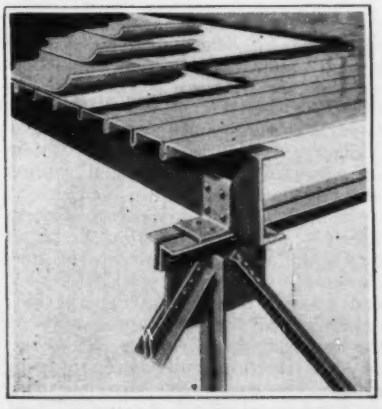


FIG. 1—CROSS-SECTION OF MAHON STEEL ROOF DECK

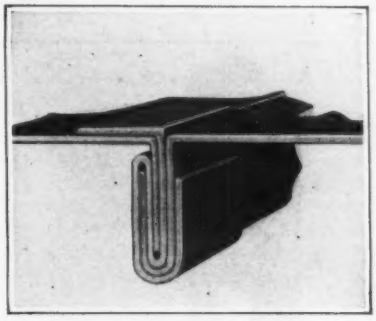


FIG. 2—INTERMEDIATE CLIP

way between purlins and a purlin clip for attaching the plates to the purlins.

The steel roof deck is furnished in copper-bearing steel, 18 and 20 gage, but can be furnished in special galvanized steel at a slight increase in cost. All plates lay 12 in. wide when installed, ribs 1½ in. deep on 6-in. centers. Every second rib where the sheets interlock

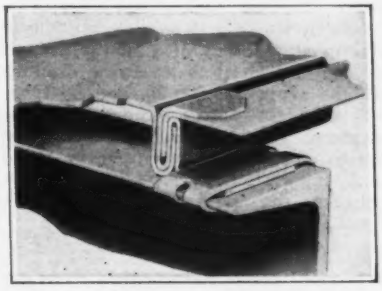


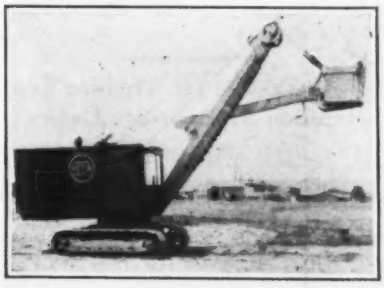
FIG. 3—PURLIN CLIP

provides three thicknesses of metal. All end lap joints are made directly over the purlins with a minimum lap of 2 in. The design of the joint is claimed to eliminate all expansion and contraction difficulties. Any standard composition roofing can be used over the steel roof deck, applied similarly to roof construction over concrete. The steel roof deck is light in weight, the 20-gage deck weighing 2½ lb. per sq.ft., and the 18-gage deck weighing 3.25 lb. per sq.ft.

A New Gasoline Shovel of 1½-1¼ Cu.Yd. Capacity

Following the placing of its Conqueror gasoline shovel on the market two months ago, the Osgood Company, Marion, Ohio, is now introducing a new model known as the Victor. The latter will carry a 22- or 24-ft. boom, a 15- or 16-ft. dipper stick and a 1½- or 1¼-yd. dipper, depending upon the requirements. For crane or dragline service a 45-ft. boom with 1½-yd. bucket or a 50-ft. boom with 1-yd. bucket may be used.

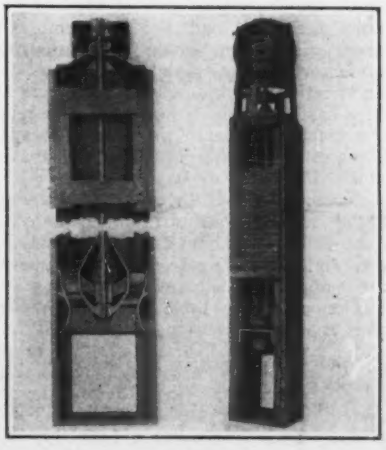
The new shovel is equipped with a combination cast-iron gasoline tank and counterweight mounted on the deck level, a large-sized gasoline engine equipped with storage battery, electric starter, voltage regulator which automatically prevents overcharging of the battery, gasoline filter, muffler and air cleaner. The company's patented mechanism for setting the clutches on the hoisting and pull-back drums, known as the Servo Mechanism, is utilized on the shovel. It is claimed that through the operation of this mechanism the engine does the work of operating the levers. The use of two drums on the machine makes it unnecessary to add to the machinery when the shovel is converted for clamshell or dragline operation. The tread is of the double-chain-drive type built entirely of steel castings. The truck frame is also a single steel casting, as are the side frames, which are of box-section bow-type construc-



tion. Power is transmitted from the vertical travel shaft to a single one-piece cross travel shaft, from which, through sprockets and chains, the power is delivered direct to the tread-belt-driving tumbler. The new machine has a traveling speed of approximately 0.7 m.p.h. and is claimed to be able to negotiate grades up to 30 per cent.

Vertical Screw Pump for Low-Head Work

A vertical screw pump unit which handles 7,200 g.p.m. against an 8-ft. head with an installation cost which is claimed to be considerably less than a centrifugal pump has recently been de-



veloped by Fairbanks, Morse & Company, Chicago, Ill. The new pumping unit is known as the Everglades screw pump, inasmuch as it was developed primarily for drainage work in Florida, although of course adaptable to any other low-head work. The pump carries a Wood screw-type impeller and diffuser and is constructed in such a way that four wooden corner posts are fastened to the cast-iron spider, and the whole structure is boarded up so that it may be placed vertically in a ditch or stream and arranged to discharge over the top of an embankment. By removing boards from one side of the box, the discharge can be placed at any height. The pump is manufactured only in a 24-in. size, so that the inside dimensions of the box are 25 in. square by 12 ft. high. An intake opening of 17x28½ in. and a discharge opening of 17x18 in. are provided as standard.

The pump is well adapted for direct connection to vertical motors or for belt drive from motors or internal combustion engines.

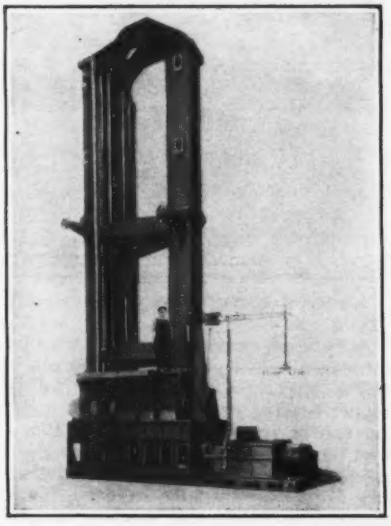
New 2,000,000-Lb. Machine Tests Hudson River Bridge Cables

The largest universal testing machine yet built, according to the manufacturer, the Riehle Brothers Testing Machine Company, Philadelphia, has been constructed for the John A. Roebling Sons Company, Trenton, N. J., for the immediate purpose of testing the cables for the 3,500-ft. span of the Hudson River bridge at New York City.

The mammoth testing machine is shown in the accompanying illustration. It will be noted that the upper or stationary head may be set in three positions by means of the insertion of keys in the slots in the columns; the screws and handwheels operate the keys. The head is raised or lowered to the desired position while the keys are handled by the crane which serves the machine. Both heads are steel castings 24 in. thick, weighing about 25,000 lb. each. They are pierced by rectangular cored slots to permit the specimen to pass through. Three pulling screws 8½ in. in diameter and one 11½ in. in diameter insure stability of the pulling head. The largest screw sustains a load of 1,000,000 lb., while each of the smaller ones sustains a load of 500,000 lb. All main gears are located beneath the table, while the speed change gears and friction clutch assembly are mounted in a cast-iron box bolted to the base of the machine beneath the balance beam. Four different pulling speeds are available. Power is derived from a 75-hp. Reliance 800-1,600-r.p.m. adjustable-speed motor transmitting through a Link-Belt silent-chain drive. A tachometer and all electrical control equipment are mounted on a panel board.

The weighing table is a one-piece steel casting 13 ft. long by 11 ft. 1 in. wide, weighing 48,850 lb. The total length of knife edge through which the table transmits its load to the lever system is in excess of 200 in. Two primary main levers carry 1,000,000 lb. A fraction of this is transmitted to a pair of secondary intermediate levers by which, now reduced to 1,000 lb., it is transmitted to the weighing beam.

A new design recoil apparatus of the hydraulic type is used. The load is weighed on a beam of the conventional type on which the poise is moved by a screw as is usual. The only unusual



feature is the use of three separate poises by which it is possible to indicate fractional readings of ¼ and ½ as well as full capacity. The entire machine weighs about 275,000 lb. and is 42 ft. 10¾ in. high. The extreme prime dimensions are 13x21 ft. The maximum length of specimen which can be tested is 25 ft., while the clear space of 75 in. between the screws provides ample room for large pieces.

Business Notes

CONCRETE STEEL COMPANY, New York City, announces the appointment of George O. With, formerly Chicago manager of the Consolidated Expanded Metal Companies, as district sales manager in charge of its Chicago office.

ATLAS PORTLAND CEMENT COMPANY, New York City, announces the incorporation of the Atlas Portland Cement Company of Texas. The latter company has recently commenced the construction of a plant at Waco. This is the first Atlas plant in Texas, this section being hitherto supplied from the company's existing plant at Independence, Kan.

TIMKEN ROLLER BEARING COMPANY, Canton, Ohio, announces the incorporation of a new company, known as the Timken Steel & Tube Company, with headquarters in Canton and sales offices in Chicago, Los Angeles, Detroit and New York. The company has been organized to produce high-grade alloy steels in mills with a capacity of 30,000 tons per month, equally divided between electric and open hearth. It is equipped to supply any section or size of hot-rolled bar stock or seamless tubing. The officers are H. H. Timken, chairman; M. T. Lothrop, president; J. W. Spray, vice-president; A. J. Sanford, vice-president in charge of sales; J. E. Daily, vice-president in charge of operations; and J. F. Strough, secretary and treasurer.

LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, announces the opening of a San Francisco office at 533 Market St. in charge of W. S. Stewart. L. P. Henderson, formerly of the Chicago office, has been placed in charge of the Minneapolis district. Robert Notvest has been transferred from Kansas City to Indianapolis, where he will be in charge. R. E. Mason has replaced Mr. Notvest at Kansas City. N. L. Nye has been stationed at Akron, Ohio, under the direction of R. P. Tarbell, manager of the Cleveland district.

New Publications

Electric Arc Welding—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., has published a 24-page booklet intended as a manual for training arc-welding operators. It is used by all the student welders at the Westinghouse welding school and is arranged in such sequence as to develop the understanding and application of principles as the student develops his skill in welding. It is a booklet that should prove of value to all contractors and manufacturers who are developing welding organizations.

Hollow Tile—HEATH CUBE SERVICE, INC., Columbus, Ohio, describes Heath Cube masonry, a simplified hollow-tile system, in a 36-page booklet which gives engineering data regarding lightness, dimensions, standards of quality, texture, and methods of estimating quantity; and also contains a number of plates showing various ways of using these cubes in the construction of masonry walls.

Arc Welding—GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has recently published two new booklets on electric arc welding. They are entitled, respectively, "Arc Welding in G-E Factories" and "Arc Welding in Industry." The first booklet contains 28 pages of illustrations and captions showing the extensive use to which arc welding has been adapted to General Electric manufacturing from the largest generator frames and girders to small blacksmith-type repair work. The second booklet follows the general ideas developed in the first and points out the uses to which various fields, such as steel erection, railway engineering, construction-equipment manufacturing, pressure-vessel manufacturing and sheet-steel manufacturing, have adapted the electric arc-welding process.

The Business Side of Construction

13 Per Cent Gain in Awards for Nine-Month Period

That the year 1928 will hang up a new record for general construction is indicated by the volume of contracts awarded in the nation during the first nine months of the year. Contracts awarded this year to date are valued at $2,682,825,000, as against $2,366,612,000 for the same period last year, a gain of 13.4 per cent. That there has been a slight reduction in the third quarter of the year is indicated by the fact that during the first six months the volume of contracts awarded was 17.2 per cent more than that during the same period in 1927.

Several classes of construction have shown significant increases during the nine-month period—streets and roads, 24 per cent; industrial building, 18 per cent; commercial buildings, 18 per cent, and federal government projects, 43.5 per cent. The greatest proportionate growth during the past quarter was that of federal projects, the value of contracts let during the third quarter being more than double that during the first half of the year. The volume of contracts awarded during the first nine months of the current year for waterworks, sewers and bridges was in each case around 10 per cent less than that during the same period last year, and excavation showed a drop of 18.7 per cent. Commercial buildings leads the volume of contracts awarded with $1,434,254,000 for the nine-month period, followed by streets and roads with a total of $510,532,000 and industrial buildings with $232,835,000.

The gain in the volume of awards since the opening of the year was witnessed in both private and public undertakings. The volume of private projects totaled $1,621,603,000, or about 15.7 per cent over that during the same period last year, and public projects reported a gain of 10 per cent. Public works appear to have maintained the gain set during the first six months of the year, but during the third quarter the gain over last year in the volume of private projects dropped from 22 per cent to 15.7 per cent.

The greatest increase over last year was recorded in the Middle Atlantic States with a gain of 45 per cent. Both the South and the Middle West reported increases of around 10 per cent over last year. On the other hand, the Far Western States as a group reported a drop of 13.8 per cent under the first nine months of 1927. New England and the states in the section west of the Mississippi also reported slight losses from last year.

September witnessed a slight reduction in the volume of contracts awarded from that reported for August, after corrections are made for the number of weeks in the two months, but an increase of about 14 per cent over the average weekly during September last year.

Every section of the nation except the Middle Atlantic States reported value of weekly contracts awarded during September under those of either the preceding month or September, 1927. The Middle Atlantic States average weekly contracts awarded during September were about 52 per cent over August and 130 per cent over September, 1927. This great gain in the Middle Atlantic States was due to a 107 per cent gain in contracts awarded for commercial buildings, and also to the awarding of two large subway contracts in New York City.

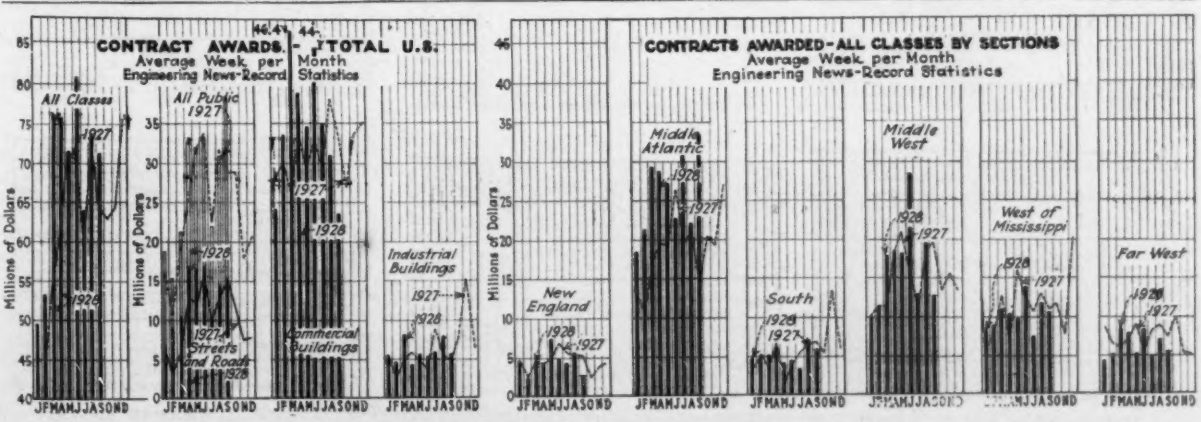
Business Continues Upward Trend

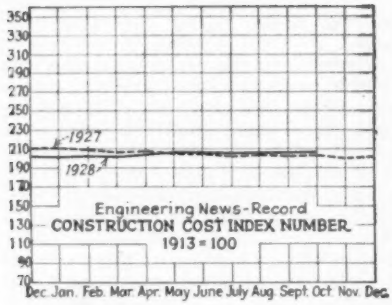
All students of business conditions seem to agree that the general business situation continues to show improvement and that there is very little doubt that fall business will be active. In a comparative sense this will become all the more apparent since the last quarter of 1927 was marked by a quiet but pronounced business recession. There are several sound reasons for believing that many of the most basic industries of the nation will record record-breaking operations for the year 1928. Automobiles, steel, copper, tires, cement, cigarettes, shoes, chemicals and the production of electricity are almost certain to be on a level higher than in any previous year. Within the last few weeks the steel industry has stepped up production to record-breaking figures for

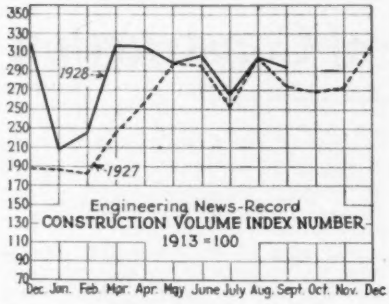
VALUE OF CONTRACTS BY SECTIONS IN THE UNITED STATES AND TOTAL FOR CANADA, SEPTEMBER, 1928

Thousands of dollars (-000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Date, U. S.	Canada
Waterworks	.....	$921	$300	$355	$1,766	$127	$3,469	$39,828	$162
Sewers	$51	3,613	209	3,839	970	734	9,416	70,128	430
Bridges	369	916	506	2,227	901	752	5,671	$3,110	741
Excavations, drainage, etc	20	621	862	1,834	3,179	298	6,814	30,053	465
Streets and roads	1,971	19,141	5,140	17,222	12,331	6,039	61,844	510,532	1,658
Industrial buildings	1,335	8,227	1,254	5,868	5,858	303	22,845	232,835	1,335
Commercial buildings	6,665	73,688	4,167	17,777	10,653	11,600	124,550	1,434,254	4,169
Federal government	51	2,864	4,815	1,451	422	890	10,493	53,490	.....
Unclassified	493	24,563	7,539	928	5,170	1,416	40,109	209,595	1,189
September, 1928	10,955	134,554	24,792	51,501	41,250	22,159	285,211	.....	10,149
August, 1928	26,693	110,846	38,251	95,793	59,186	35,794	367,563	.....	15,449
September, 1927	25,720	72,966	34,326	97,731	54,184	36,712	321,639	.....	.....
Year to date, 1928	176,466	1,012,394	203,344	648,183	396,475	245,963	.....	2,682,825	117,153
Year to date, 1927	188,229	697,201	185,630	594,339	416,063	285,150	2,366,612	.....	88,537




1927
1928
Engineering News-Record
CONSTRUCTION COST INDEX NUMBER
1913 = 100
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


1928
1927
Engineering News-Record
CONSTRUCTION VOLUME INDEX NUMBER
1913 = 100
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

ENGINEERING NEWS-RECORD CONSTRUCTION COST AND VOLUME INDEX NUMBERS

this season of the year, in spite of subnormal demand from the railroads, which, as measured by the past, are the largest consumers of steel. Steel is apparently going directly into consumption, since, in spite of large shipments, steel manufacturers throughout the country are building up a large volume of unfilled orders.

It seems probable that production of automobiles for both domestic and foreign consumption during 1928 not only will exceed the record production of 4,503,000 cars made in 1926 but will approximate 5,000,000 cars for the current year.

Contracts for general construction awarded during 1928 promise to exceed 1927 by at least 10 per cent and may reach even 14 per cent. There appears to be very little let-up in the volume of commercial and industrial building planned for the near future, although it is probable that, due to the present high money rates, many projects are being held in abeyance, probably until after the opening of the year.

The money situation is marked by rates paid for borrowed funds that have not been quoted since 1921, but at the same time there is no real shortage of funds for commercial purposes at rates materially below those charged for speculative purposes. While no severe money shortage is expected, there seems to be every indication that there can be no marked relaxation in money rates before the opening of 1929.

Business profits have been and are increasing, aided by both expanding volume and small inventory profits, resulting from generally higher price levels. The most striking feature of the present business situation continues to be optimism concerning the future.

Construction Cost and Volume Index Numbers

Engineering News-Record Construction Cost Index Number is 207.71, compared with 207.29 on Sept. 1. It is 3.31 points higher than a year ago.

The Construction Volume Index Number is 10 points below that of August and is 23 points above the September, 1927, number.

Monthly figures for the years 1927 and 1928 follow:

E. N.-R. Cost		E. N.-R. Volume	
Oct., 1928	**207.71**	**Sept., 1928**	**296**
Sept., 1928	207.29	August, 1928	306
Oct., 1927	204.40	Sept., 1927	273
Peak June, 1920	273.80	1927 (average)	263
1927 (average)	206.24	1926 (average)	228
1913 (average)	100.00		
1927		1927	
January	211.50	January	187
February	210.15	February	182
March	208.80	March	226
April	209.00	April	257
May	206.80	May	299
June	205.55	June	297
July	203.68	July	252
August	205.50	August	306
September	203.60	September	273
October	204.40	October	269
November	201.98	November	272
December	203.90	December	319
1928		1928	
January	203.90	January	208
February	204.65	February	225
March	204.65	March	318
April	206.40	April	316
May	207.00	May	299
June	206.15	June	308
July	206.65	July	266
August	207.29	August	306

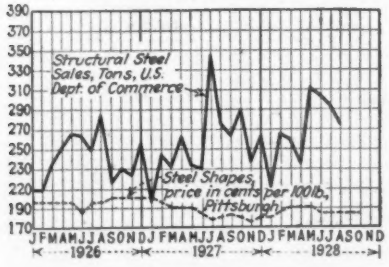
Cost Index Reaches New High for Year

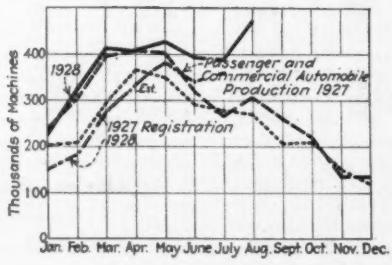
The *Engineering News-Record* Construction Cost Index Number for October was the highest recorded since April, 1927. During the past eleven months the cost index has increased almost steadily, advancing 5.73 points during that period. The current October index was 3.31 points higher than the index for October last year. The cost index, however, is still about 24 per cent under the peak of 1920, but 108 per cent above the monthly average of 1913.

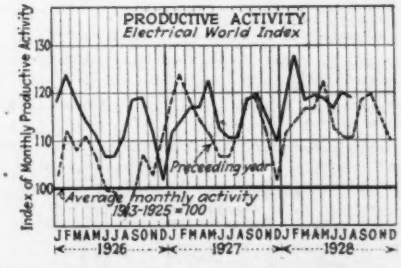
The September *E. N.-R.* Construction Volume Index Number fell slightly under that of August but was still 8.5 per cent above the index of September last year. The September index is 7 per cent under the peak recorded for the year in March. Construction is holding up much better than at this time last year, the drop in September, 1927, being almost 11 per cent, as against only 3 per cent during the current September. The latest figures, with comparisons, are given in the accompanying panel.

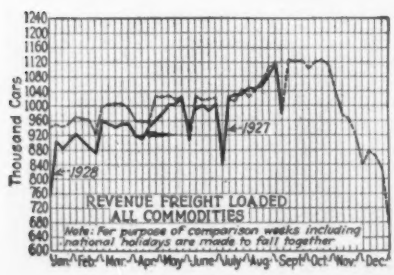
Labor Demands the Five-Day Week With Increased Wages

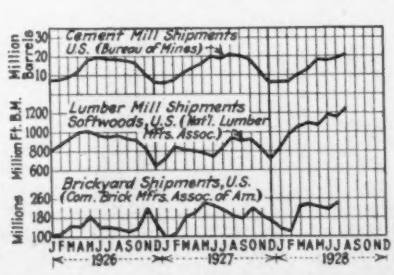
The five-day week is one of the major objectives of organized labor, according to William Green, president of the American Federation of Labor. "High wages," he says, "must be preserved even in the face of much unemployment. Reducing wages would only make the situation worse in the communities where there are un-

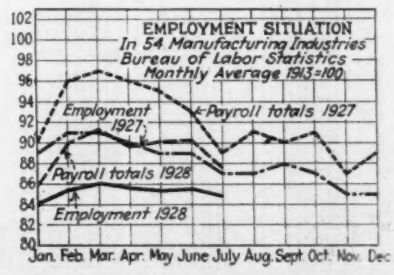

Structural Steel Sales, Tons, U.S. Dept. of Commerce
Steel Shapes, price in cents per 100 lb., Pittsburgh
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926
1927
1928




PRODUCTIVE ACTIVITY
Electrical World Index
Index of Monthly Productive Activity
Preceding year
Average monthly activity 1913-1925 = 100
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926
1927
1928


Thousand Cars
1927
1928
REVENUE FREIGHT LOADED
ALL COMMODITIES
Note: For purpose of comparison weeks including national holidays are made to fall together
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


Million Barrels
Cement Mill Shipments U.S. (Bureau of Mines)
Million Ft. B.M.
Lumber Mill Shipments Softwoods, U.S. (Nat'l. Lumber Mfrs. Assoc.)
Millions
Brickyard Shipments, U.S. (Com. Brick Mfrs. Assoc. of Am.)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926
1927
1928


EMPLOYMENT SITUATION
In 54 Manufacturing Industries
Bureau of Labor Statistics
Monthly Average 1913 = 100
Employment 1927
Payroll totals 1927
Payroll totals 1928
Employment 1928
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

PRODUCTION AND MOVEMENT OF MATERIALS—ELECTRICAL ENERGY CONSUMED—EMPLOYMENT OF LABOR

employment problems, because it would reduce the purchasing power of those workers who are employed."

Building trades mechanics in New York City to the number of 124,000 are preparing to place demands for the five-day week and a 10 per cent increase in wages before the Building Trades Employees Association of that city. The craftsmen are now receiving $12 per day for an eight-hour day, or $66 per 5½-day week. The proposed increase would bring them to a scale of $13.20 per eight-hour day, or $66 for a five-day week. Any change in the present schedule would violate the existing contract between the Building Trades Council and the employees, which does not expire until Dec. 31, 1929.

The average skilled building trades rate for the country is $1.35⅜ per hour, as against $1.35 in September and $1.33⅜ in October, 1927. Common laborers receive an average rate of 56.28c. per hour, compared with 56.07c. in September and 54.5c. in October, 1927.

A shortage of bridge and structural steel workers exists throughout the United States and Canada as a result of the widespread activity in big building, bridges and viaducts and other large structures requiring steel work, reported several delegates to the annual convention of the International Bridge and Ornamental Iron Workers, held in St. Louis in September. Chicago was also reported as needing 800 additional steel workers of experience, while St. Louis needs at least 100 additional workers if present plans in the hands of architects are to be carried out. Many Eastern cities are also seeking steel workers in the construction line.

August and September witnessed a falling off in the number and volume of new construction projects in St. Louis, and there was a gradual tapering off in the numbers of building mechanics regularly employed, although the grand total of workers in the building crafts is about the same as at this time last year.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.25@1.40	$0.60@0.70	$0.60@1.00	$0.50	.....	$0.75@1.25	$0.25@.35
Baltimore	1.62½	1.00@1.10	1.00@1.37½	1.00	$0.65	1.00@1.25	.35
Birmingham	1.50	1.00	1.25	.50	.....	1.75	.25@.40
Boston	1.50	1.37½	1.37½	.85	1.27½	1.37½	.45@.80
Cincinnati	1.50	1.37½	1.37½	.92½	1.37½	1.37½	.45@.60
Chicago	1.62½	1.50	1.00@1.50	.90@.96¼	1.50	1.50	.90
Cleveland	1.62½	1.37½	1.37½	.87½	1.10	1.50	.87½
Dallas	1.67½	1.12½	1.25	.40@.75	1.25	1.25	.35@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00	.....	1.25	.37½@.62½
Detroit	1.56¼	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.50@.60
Kansas City	1.50	1.25	1.25	.90	1.25	1.25	.35@.75
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.50
Minneapolis	1.25@1.37½	.87½@.95	.87½	.75	.....	1.00	.45@.60
Montreal	1.12	.75	.75	.40	.50	1.00	.30@.35
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.75	1.50	1.75	1.12½	1.00@1.12½	1.75	.90½
Philadelphia	1.62½	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	.45@.75
Pittsburgh	1.70	1.50	1.43¾@1.56¼	1.12½	.....	1.50	.40@.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.50	.45@.75
San Francisco	1.37½	1.12½	1.00@1.12½	.87½	1.12½	1.37½	.50@.60
Seattle	1.50	1.12½	1.25	1.00	1.12½	1.25	.70

Seasonal Keen Competition Among Dealers

As is usual at this season of the year, reports indicate increased competition among dealers of construction materials because they are especially keen to book all the business possible before the winter sets in. As a result there are many instances of price cutting reported, although in general building material prices continued the upward movement which started in July, the October cost index being the highest since April, 1927.

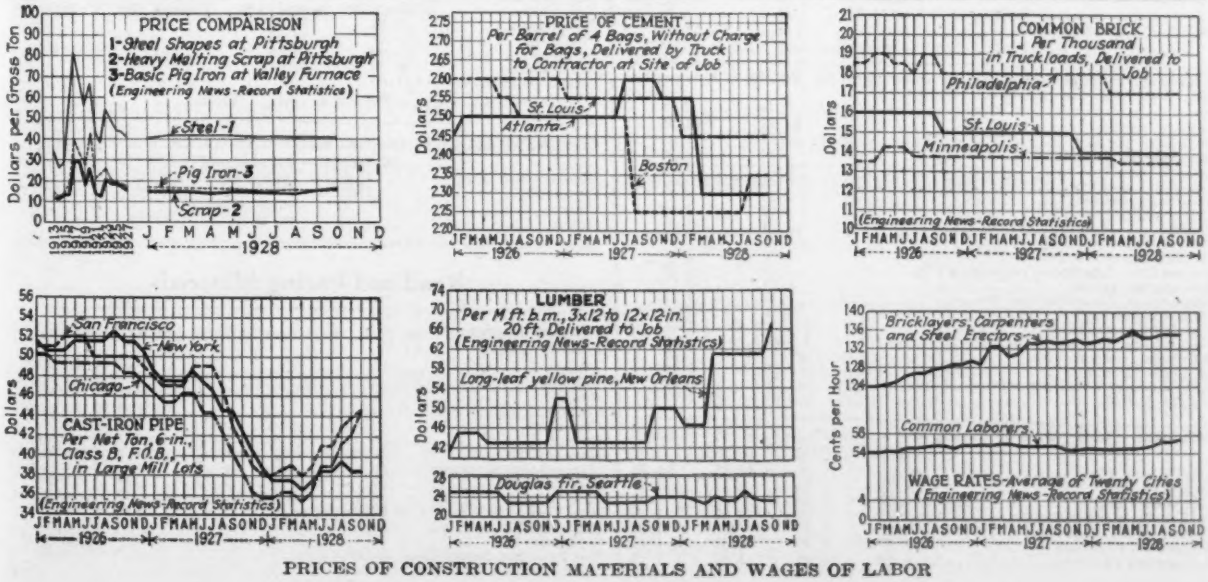
Cement prices showed their usual stability, there being no change in 46 cities reporting. New Orleans, however, reported a rise of 20c., or to $2.40 per barrel delivered, and Dallas reported a drop of 25c., or to $2.15 per barrel. Price cutting to a very slight extent prevails in most cities.

Pine and fir lumber prices experienced a general advance due to curtailment of output at Southern and Western mills. The sudden demand from the storm-stricken regions of Florida and Porto Rico has caused an abrupt rise in the price of longleaf yellow pine in the New Orleans district. Price of large timbers in New Orleans increased 10 per cent.

Common brick prices are expected to continue steady until Hudson River navigation is closed by ice. Prices in Dallas, however, advanced $1.50 per thousand, while a drop of 25c. per thousand was reported from Boston.

Steel sheets, blue annealed, dropped 10c., or to $2 per 100 lb. f.o.b. Pittsburgh; reinforcing bars were down 5c. per 100 lb., or to $1.90 f.o.b. Pittsburgh in large lots, and standard section angle bars advanced 5c., or to $2.75 and $2.80 per 100 lb., Pittsburgh mill. A rise of 50c. per ton in the price of cast-iron pipe was recorded in the Birmingham district, but prices were stable elsewhere.

A general downward price trend was recorded for lime, following a similar trend in the price of gypsum. At Pittsburgh the price dropped $1 per ton. Asphalt was also quoted at a lower price, declining by $1.50 per ton (package) in Dallas and 25c. per ton (bulk) in Boston.


PRICE COMPARISON
1-Steel Shapes at Pittsburgh
2-Heavy Melting Scrap at Pittsburgh
3-Basic Pig Iron at Valley Furnace
(Engineering News-Record Statistics)
Steel-1
Pig Iron-3
Scrap-2
Dollars per Gross Ton
J F M A M J J A S O N D
1928
PRICE OF CEMENT
Per Barrel of 4 Bags, Without Charge for Bags, Delivered by Truck to Contractor at Site of Job
St. Louis
Atlanta
Boston
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928
COMMON BRICK
Per Thousand in Truckloads, Delivered to Job
Philadelphia
St. Louis
Minneapolis
(Engineering News-Record Statistics)
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928
CAST-IRON PIPE
Per Net Ton, 6-in., Class B, F.O.B., in Large Mill Lots
San Francisco
New York
Chicago
(Engineering News-Record Statistics)
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928
LUMBER
Per M ft. b.m., 3x12 to 12x12 in. 20 ft., Delivered to Job
(Engineering News-Record Statistics)
Long-leaf yellow pine, New Orleans
Douglas fir, Seattle
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928
Bricklayers, Carpenters and Steel Erectors
Common Laborers
WAGE RATES-Average of Twenty Cities
(Engineering News-Record Statistics)
Cents per Hour
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928

PRICES OF CONSTRUCTION MATERIALS AND WAGES OF LABOR

Current Prices of Construction Materials

Price advances since last month are in icated by **heavy type;** declines by *italics*

Building Materials

PORTLAND CEMENT—Prices per bbl. delivered to contractors, in carloads, *without charge for bags.* Cash discount not deducted.

	Oct. 4, 1928	One Month Ago	One Year Ago
Atlanta	$2.30	$2.30	$2.40
Baltimore	2.65	2.65	2.50
Birmingham	2.60	2.60	2.40
Boston	2.35	2.35	2.05f.o.b.
Cedar Rapids (f. o. b.)	2.24	2.24	2.24
Chicago (f. o. b.)	2.05	2.05	2.05
Cincinnati (f. o. b.)	2.22	2.22	2.32
Cleveland (f. o. b.)	2.24	2.24	2.24
Dallas	*2.15*	2.40	2.05f.o.b.
Davenport (f. o. b.)	2.24	2.24	2.24
Denver	2.55f.o.b.	2.85	2.85
Detroit (f. o. b.)	1.95	1.95	2.00
Duluth (f. o. b.)	2.04	2.04	2.04
Indianapolis, (f. o. b.)	2.19	2.19	2.19
Jersey City	2.35	2.35	2.13f.o.b.
Kansas City, Mo.	2.20	2.20	2.07f.o.b.
Los Angeles	2.66	2.66	2.56
Milwaukee (f. o. b.)	2.20	2.20	2.20
Minneapolis (f. o. b.)	2.22	2.22	2.22
Montreal (f. o. b.)	1.41	1.41	1.41
New Orleans	**2.40**	2.40	2.07f.o.b.
New York	2.25@2.35	2.25@2.35	2.35
Peoria (f. o. b.)	2.22	2.22	2.22
Philadelphia	2.41	2.41	2.40
Pittsburgh (f. o. b.)	2.04	2.04	2.04
St. Louis	2.45	2.45	2.05f.o.b.
St. Paul (f. o. b.)	2.22	2.22	2.22
San Francisco	2.41	2.41	2.51
Seattle	2.70	2.70	2.65
Toledo (f. o. b.)	2.20	2.20	2.20

Current mill-prices per barrel, in carloads, without bags, f.o.b., to contractors:

Alpena, Mich.	$1.65	Leeds,Ala.	$1.65
Buffington, Ind.	1.80	Lehigh Valley District	1.75
Clinchfield, Ga.	1.65	Mason City, Ia.	1.80
Fordwick, Va.	2.05	Mitchell, Ind.	1.90
Hannibal, Mo.	1.90	North Birmingham, Ala.	1.45
Hudson, N. Y.	1.75	Richard City, Tenn.	1.85
Iola, Kan.	1.85	Steelton, Minn.	1.85
Kingsport, Tenn.	2.05	Universal, Pa.	1.80
La Salle, Ill.	1.90	Wyandotte, Mich.	1.70

SAND AND GRAVEL—Prices are per cu.yd. delivered. Weight of sand, 1½ tons per cu.yd.; gravel, 1½ tons per cu.yd. unless otherwise specified in pounds.

	Gravel		Sand
	1½ In.	¾ In.	
Atlanta, per ton	*$2.50*	*$2.50*	$2.50
Baltimore, per ton	2.40	2.60	1.70
Birmingham (2,600)	3.00	3.00	2.65
Boston, per ton	1.90	1.90	1.35
Chicago	2.05@2.20	2.05@2.20	2.05@ 2.20
Cincinnati, per ton	1.90	1.90	1.60
Dallas	2.50	2.50	2.25@ 3.00
Denver (2,700)	1.80	1.80	1.30
Detroit (2,600)	**3.25**	**3.25**	**2.75**
Kansas City, Mo.	2.40	2.40	.60 ton at pit
Los Angeles, per ton	2.15	2.15	1.30
Minneapolis (2,800)	2.25 ton	2.25 ton	1.00
Montreal, per ton	1.90	1.50	1.20
New Orleans (2,700) (2,500)	**3.00**	**3.00**	**2.00**
New York	3.25@3.50	3.25@3.50	2.00@ 2.25
Philadelphia, per ton	2.05@2.90	2.05@2.90	1.40@ 2.25
Pittsburgh, per ton, f.o.b.	....	....	1.25
St. Louis, per ton	*1.90*	*1.90*	*1.60@1.90*
San Francisco (bunkers) (2,800)	1.80	1.80	1.40
Seattle (3,200) (2,850)	1.00	1.00	1.00

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Prices are per cu.yd. delivered. Weight 1½ tons per cu. yd., unless otherwise specified in pounds:

	1½ In.	¾ In.
Atlanta, per ton	**$3.25**	**$3.25**
Baltimore, per ton	2.75	2.85
Birmingham, Limestone	2.50	2.50
Boston, per ton	2.25	2.25
Chicago, Limestone	2.05@2.20	2.05@2.20
Cincinnati, per ton	2.25	2.25
Cleveland, per ton	3.00	3.00
Dallas	3.25	3.40
Denver, Granite (2,700)	2.50	2.50
Detroit, Limestone, per ton	2.50	2.60
Kansas City, Limestone, per ton, (2,450)	2.50	2.50
Los Angeles, per ton	2.15	2.15
Minneapolis, Limestone, per ton	2.25	2.25
Montreal, per ton	2.10	2.10
New York, Limestone	3.25@3.50	3.25@3.50
Philadelphia, Limestone, per ton	2.30@3.15	2.30@3.15
Pittsburgh, per ton, f.o.b.	2.75	2.75
St. Louis, per ton	2.20	2.20
San Francisco, Trap rock, bunkers (2,400)	1.70	1.70
Seattle, (2,700)	1.90	1.90

CRUSHED SLAG—Price of crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Birmingham, Ala.	$ .90	$1.25	$2.05	$0.80
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.30
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	....	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown District	1.30	1.40	2.00	1.30

HOLLOW TILE—Price of hollow building tile per block delivered to contractor in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.0808	.....	$0.1516	.....	$0.2232
Baltimore	.095	.....	.173	.....	.232
Birmingham	.09	$0.127	.174	.....	.....
Boston	.08	.1025	.14	$0.1775	.24
Chicago	.076	.104	.142	.182	.202
Cincinnati	.074	.....	.136	.....	.205
Cleveland	.06	.....	.128	.....	.....
Dallas	.096	*.12*	*.178*	.....	.284
Denver	.0975	.135	.175	.2125	.25
Detroit	.092	.127	.208	.256	.293
Kansas City	.0535	.....	.158	.....	.242
Los Angeles	.085	.122	**.175**	.232	.285
Minneapolis	.0842	.....	.1476	.....	.2441
Montreal	.12	.....	.22	.....	.315
New Orleans	.09	.125	.165	.22	.245
New York	.0973	.1459	.1824	.....	.....
Perth Amboy, N. J. (f.o.b.)	.....	.....	.....	.252	.312
Philadelphia	.11	.145	.22	.27	.34
Pittsburgh	.068	.....	.1175	.....	.1726
St. Louis	.078	.105	.145	.175	.210
San Francisco	.108	.156	.255	.....	.....
Seattle	.10	.....	.18	.....	.26

BRICK—Contractors price, delivered, per M, is as follows:

	Common	Paving 3x8¼x4-in.	Paving 3¼x8¼x4-in
Atlanta	$13.75	$38.00	$45.00
Baltimore	15.00	40.00	45.00
Birmingham	15.00	32.00	36.00
Boston	*17.25*	45.00	*50.00*
Chicago	12.00	42.00	45.00
Cincinnati	18.00	40.00	45.00
Cleveland	14@16	.....	.....
Dallas	**14.50**	35.00	.....
Denver, salmon	12.00	.....	.....
Detroit	15.50	35.50	38.50
Kansas City	14.00	.....	.....
Los Angeles	11.00	.....	.....
Minneapolis	13.50	.....	.....
Montreal	20.33	.....	.....
New Orleans	16.00	40.00*	50.00
New York	17@20	45.00	51.00
Philadelphia	17.00	40.00	46.00
Pittsburgh	17.00	.....	.....
St. Louis, salmon	14.00	*37.50*	*40.00*
San Francisco	13.00	.....	.....
Seattle	14.50	50.00	55.00

*2¼x8¼x4 in.

LIME—Prices delivered to job:

	Hydrated, per Ton—Finishing	Hydrated, per Ton—Common	Lump, per Barrel—Finishing	Lump, per Barrel—Common
Atlanta	$27.50	$15.00	$2.30†	$2.10†
Baltimore	20.00	14.00	2.55†	.....
Birmingham	22.00	16.00	2.40†	1.85†
Boston	20.00	**14.25**	3.85*	3.00*
Chicago	20.00	**18.00**	.....	1.50†
Cincinnati	16.80	13.20	.....	13.20‡
Dallas	**20.00**	.....	.....	18.00‡
Denver	32.00	23.75	3.80*	3.00*
Detroit	19.20	14.80	2.20†	2.20†
Kansas City	20.00	17.50	2.62†	2.25†
Los Angeles	25.00	18.00	2.85†	17.00‡
Minneapolis	25.50	21.00	.....	1.70†
Montreal	21.00	21.00	.....	15.00‡
New Orleans	.....	.....	.....	2.80*
New York	21.00@22.00	14.00@15.00	4.00@4.10*	3.15@3.25*
Philadelphia	22.00	15.00	.....	.....
Pittsburgh	*20.00*	18.00	.....	.....
St. Louis	24.00	18.00	2.50†	15.00‡
San Francisco	27.50	20.00	.....	1.70†
Seattle, paper sacks	24.00	.....	.....	2.80*

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

CONCRETE BLOCKS—Standard, 8x8x16-in., hollow, delivered to job, each:

Boston	$0.18@.20	Minneapolis, f.o.b.	$0.14
Brooklyn and Queens	15@.17	New Orleans	.22
Cleveland	.17@.18	Philadelphia	.18@.25
Denver	.22	Pittsburgh	.18
Detroit	.15	St. Louis	.18

Road and Paving Materials

PAVING STONE—Prices, f.o.b., in carloads or cargo lots for granite blocks 4x8x4-in. dressed:

Atlanta	$3.00 per sq.yd.
Baltimore	3.00 per sq.yd.
Boston	135.00 per M.
Chicago, 5 in.	3.25@3.90 per sq.yd.
Cincinnati	110.00 per M.
Detroit, 5 in.	3.00 per sq.yd.
Kansas City	3.50 per sq.yd.
Minneapolis, Sandstone	2.74 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.75 per sq.yd.
New York, 5 in. Grade 1, 30 blocks per sq.yd.	150.00 per M.
Philadelphia	125.00 per M.
St. Louis	3.30@3.40 persq.yd
San Francisco, Basalt block, 4x7x8	70.00 per M.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Prices f.o.b. in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	18	2.40
Chicago	3½	16	2.10
Cincinnati	3½	16	2.35
Dallas	4	18	3.90
Detroit	3½	16	1.94
Kansas City	3½	16	3.85
Minneapolis	3½	16	2.50
Montreal	4	16	4.50
New Orleans	3½	16	2.30
New York	3½	16	2.70
St. Louis	3½	16	2.30

FLAGGING—Prices in fair-sized quantities, alongside dock, New York: Manhattan and Bronx, 4 ft. wide, 24c. per sq.ft.; Queens, 5 ft. wide, 26c. per sq.ft.; Cross-walk, 6x24-in., $1.30 per lin.ft.

CURBING—*New York*: Bluestone, f.o.b. barge, New York, 5x16 in., rough, 90c. per lin.ft., cutting charges extra. *Birmingham*: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft. *St. Louis*: Class "B" straight, delivered, 5x16 in., 80c. per lin. ft.; roundings, $1.15 per lin.ft.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
Atlanta (Mexican)	$22.60	$18.40
Baltimore (Standard Oil, f.o.b. refinery)	21.75	17.75
Birmingham (Mexican)	27.00	21.00
Boston (Mexican)	24.50	*18.25*
Chicago (Texas)	24.50	21.30
Cincinnati (Kentucky Rock)	.....	11.65
Dallas (Texas)	*24.50*	.....
Denver (California)	35.00	.....
Detroit (Mexican)	24.00	19.00
Kansas City, Mo. (Texas)	27.00	25.00
Los Angeles ("D" Grade, Calfornia, f.o.b. El Segundo)	18.00	12.00
Maurer, N. J. (Bermudes)	30.00	.....
Maurer, N. J. (Trinidad)	23.00	.....
Minneapolis, (Stanolind, f.o.b. Twin Cities)	29.10	*20.10*
Montreal (Imperial)	28.00	21.50
New Orleans (Mexican)	20.00	17.00
New York (Texas)	24.50	16.50
Philadelphia (Mexican)	20.00	18.00
Pittsburgh	26@30	14@18
St. Louis (Mexican)	23.50	19.50
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18.00	12.00
Seattle, ("D" grade, California, f.o.b Richmond refinery)	19.50	13.50

ROAD OILS—Price, f.o.b. in tank cars, 8,000 gal. minimum, per gal.:

Birmingham, 40@50% asphalt	$0.0525
Birmingham, 50@60% asphalt	.0475
Dallas, 40@50% asphalt	.06
Dallas, 50@60% asphalt	.06
New York, 40@50% asphalt (at terminal)	.06
New York, 50@60% asphalt (at terminal)	.06
St. Louis, 40@50% asphalt	.0385
St. Louis, 50@60% asphalt	.0385

Iron and Steel

PIG IRON—Per gross ton, f.o.b.:

Birmingham, No. 2 fdry., silicon 2.25@2.75	$15.25
Pittsburgh, basic, incl. freight ($1.76) from Valley	19.26

STRUCTURAL STEEL—Per 100 lb.:

	Shapes, 3 to 15-In.	Plates, ¼-In
Birmingham, large mill lots, f.o.b.	$2.05	$2.05
Chicago, warehouse, delivered	3.10	3.10
Dallas, warehouse, delivered	3.75	3.75
New York, warehouse, delivered, 250 to 3,999 lb.	3.30	3.30
Pittsburgh, large mill lots, f.o.b.	1.85*	1.85*
St. Louis, warehouse, delivered	3.25	3.25
San Francisco, warehouse, delivered	3.25	3.25

*As of Sept. 27, 1928.

BARS, CONCRETE REINFORCING—Per 100 lb. for ½-in.:

Birmingham, large mill lots, f.o.b.	$2.05
Chicago, warehouse, delivered	2.30@3.00
Dallas, warehouse, delivered	3.50
New York, warehouse, delivered, 250 to 3,999 lb.	3.25
Pittsburgh, large mill lots, stock lengths, f.o.b.	*1.90*
St. Louis, warehouse, delivered	3.15
San Francisco, warehouse, delivered	2.25

EXPANDED METAL LATH—Per 100 sq.yd., painted, delivered to job in less-than-carload lots:

Lb. per Sq. Yd.	New York	Birmingham	Chicago	St. Louis	Dallas	San Francisco
2.2	$15.00	$19.00	$14.00	*$18.50*	$21.50	$18.50
2.5	16.00	20.00	15.00	*19.50*	24.00	19.50
3.0	17.50	22.50	16.50	*21.00*	.....	22.00
3.4	20.00	24.50	18.00	*22.50*	30.00	24.00

WIRE REINFORCEMENT FOR CONCRETE—Price per 100 sq.ft.in carloads at mills; from warehouses in lots of 10,000 sq.ft. or over; plain 4 in. by 4 in. mesh:

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.99	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.26	1.29	1.76	1.35	1.38	1.55
068	35	1.54	1.58	2.18	1.66	1.67	1.91
093	45	1.98	2.03	2.79	2.13	2.00	2.46
126	57	2.45	2.51	3.45	2.63	2.55	3.03
153	68	2.92	2.99	4.13	3.14	3.15	.....
180	78	3.35	3.43	4.73	3.60	3.47	.....

STEEL SHEETS—Per 100 lb.:

	Blue Annealed No. 10	Black No. 24	Galvanized No. 24
Chicago, warehouse, delivered	$3.35	$3.80	$4.65
New York, warehouse, delivered	3.90*	4.20	4.95
Pittsburgh, large mill lots, f.o.b.	*2.00@2.10*	*2.60@2.65*	3.60@3.70
St. Louis, warehouse, delivered	*3.45*	*4.10*	*4.85*
San Francisco, warehouse, delivered	4.00	5.00	5.40

*250 to 3,999 lb.

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	20%
Galvanized iron rigging and guy rope (*add to list*)	12½%
Galvanized steel rigging and guy rope	7½%
Plow steel round strand rope	35%
Round strand iron and iron tiller	5%
Special steel round strand rope	30%

Discount 5 points less than discount for Eastern territory: California, Oregon, Nevada, Washington, Wyoming, New Mexico, Colorado, North Dakota, Nebraska, Kansas, Oklahoma and Texas. Discount 10 points less than discount for Eastern territory: Arizona, Montana, Idaho and Utah.

RIVETS—Per 100 lb., full packages:

	Round-head Structural, ½-In.	Cone-head Boiler, ½-In.
Chicago, warehouse, delivered	$3.60	$3.90
Dallas, warehouse, delivered	5.00	5.30
New York, warehouse, delivered	5.00	5.30
Pittsburgh, large mill lots, f.o.b.	2.90	3.20
St. Louis, warehouse, delivered	3.75	4.05
San Francisco, warehouse, delivered	5.75	6.05

STEEL SHEETPILING—The base price f.o.b. Pittsburgh for large mill lots is $2.25 per 100 lb.

SHIP SPIKES—Per 100 lb., black, from warehouse stocks; galvanized about $1.75 per 100 lb. higher:

	½-In.	⅝-In.	¾-In.
San Francisco	$5.80	$5.10	$4.95
Seattle	7.75	5.65	5.50

Pittsburgh base in lots of 200 kegs or more, $3.00 per 100 lb.

NAILS—The following quotations are per 100 lb. keg delivered from warehouse stocks, also Pittsburgh mill base:

	Pittsburgh Mill	Birmingham	Chicago	St. Louis	Dallas	San Francisco	Montreal
Wire	$2.55	$3.10	$3.10	$2.75	$3.75	$3.60	$4.95
Cut	2.70@2.80	3.30	....	....	5.00	5.00	5.00

SCRAP—The prices following are f.o.b. per ton paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Detroit Per Gross Ton
No. 1 railroad wrought	$10.75@$11.25	$13.50@$14.00	.....
Stove plate	9.00@9.50	13.50@14.00	.....
No. 1 machinery cast	15.00@16.00	15.25@15.75	*$13.00*
Machine shop turnings	7.50	7.25@7.75	8.50@8.75
Cast borings	6.50@7.50	10.00@10.50	9.00
Railroad malleable	10.00	14.25@14.75	.....
Re-rolling rails	11.50@12.00	16.00@16.50	*12.00*
Re-laying rails, 56@60 lb.	23.00@24.00	23.00@25.00	.....
Heavy melting steel, No. 1	11.50	13.00@13.50	12.50@12.75
Iron and steel pipe	10.75	.....	8.25

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carload lots of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.71*
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15†
Chicago	.34	Philadelphia	.32
Cincinnati	.27	St. Louis	.405
Cleveland	.19	St. Paul	.60
Denver	1.15†		

*Except iron or steel pipe and fittings. †Minimum weight on structurals, 60,000 lb.

Railway Materials and Supplies

STEEL RAILS—Per gross ton, f.o.b., for large mill lots:

	Pittsburgh	Birmingham	Chicago
Standard bessemer rails	$43.00	$43.00	$43.00
Standard openhearth rails	43.00	43.00	43.00
Light rails, 25 to 45 lb.	36.00	34@36	36@38
Re-rolled rails	30@32	34@36	.....

RAILWAY TIES—For fair-sized orders, f. o. b., the following prices per tie hold:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.10	$1.30
	Creosoted—prices on application.		
Birmingham	Southern pine, untreated	1.10	1.25
	Southern pine, creosoted	1.60	1.75
Chicago	White oak, untreated	1.40	1.78
	Oak, empty cell, creosoted	1.80	2.40
	Oak, zinc treated	1.60	2.10
	Southern pine, creosoted	1.60	2.10
St. Louis	White oak, untreated	*1.10*	*1.70*
	Red oak, creosoted	*1.45*	2.40
San Francisco	Sap pine or cypress, untreated	.80	*1.30*
	Douglas fir, green, untreated	.82	1.14
	Douglas fir, empty cell, creosoted	1.73	2.32
Montreal	Birch or maple, untreated	.75	1.25
	Birch or maple, creosoted	1.25	1.55

Current Prices of Construction Materials

Railway Supplies—Continued

TRACK SUPPLIES—Per 100 lb. f.o.b. Pittsburgh mill for large mill lots together with warehouse prices at other places named:

	Pittsburgh	Chicago	Birmingham	St. Louis	San Francisco
Standard spikes, 7/16-in. and larger	$2.80	$3.55	$3.00	$3.65	$3.85
Track bolts	3.80	4.55	3.90	4.65	4.85
Standard section angle bars, splice bars or fish plates	2.75@2.80	3.40	3.00	4.00	4.25
Tie plates	2.15	2.15*	.....	.....	.....

*At Chicago mills in carloads.

Pipe

WROUGHT-STEEL PIPE—Discounts from standard list:

	1 to 3-In. Butt Weld		2½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Chicago, warehouse, delivered	54%	41%	51%	38%
New York, warehouse, delivered	50%	36%	45%	32%
Pittsburgh, large mill lots, f.o.b.	62½%	50½%	59%	47½%
St. Louis, warehouse, delivered	49%	36%	46%	33%

CAST-IRON PIPE—Price per net ton for bell and spigot pipe, Class B and heavier, f.o.b., in large mill lots:

	4-In.	6-In. and Over
Birmingham mill	$37.50	$34.50
Burlington (N. J.) mill	39.00	36.00
Chicago	47.20@48.20	44.20@45.20
New York	41.60	38.60
Pittsburgh	46.00	43.00
St. Louis	43.10	40.10
San Francisco	47.50	44.50

Gas pipe and Class A $3.00 per ton extra.

SEWER PIPE—Prices are delivered in cents per foot for standard pipe; 6, 8 and 12-in. single strength and 18, 24, 30 and 36-in. double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.20	$0.34	$0.75	.....	$1.70	.....	.....
Baltimore	.16	.24	.46	.....	1.53	.....	$6.50
Birmingham	.135	.2215	.4015	$1.4685	2.665	$3.90	5.06
Boston	.15	.27	.51	1.20	1.85	3.00	5.50
Chicago	.16	.28	.54	1.25	2.25	.....	.....
Cincinnati	.135	.21	.405	.75	1.35	2.16	4.8175
Dallas	.256	.42	.794	1.70	3.00	.....	.....
Denver (f.o.b.)	.161	.23	.414	.816	1.44	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	.....	.....
Kansas City	.21	.29	.52	.....	1.90	3.80	.....
Los Angeles	.21	.27	.486	.....	1.74	.....	.....
Minneapolis (f.o.b.)	.1575	.25	.45	.85	1.80	3.75	4.94
Montreal	.36	.53	.78	1.48	2.75	4.20	.....
New Orleans	*.186*	*.310*	*.527*	*.918*	*1.755*	.....	.....
New York	.20	.32	.61	1.50	2.70	5.12	7.91
Philadelphia (f.o.b.)	.117	.182	.351	1.025	1.845	3.60	5.6375
Pittsburgh (f.o.b.)	.0945	.147	.2835	.90	1.62	3.024	4.8175
St. Louis	.1545	.26	.468	.78	1.872	3.65	4.80
San Francisco	.21	.30	.54	1.32	2.16	3.60	.....
Seattle	.22	.30	.54	1.26	2.16	3.60	.....

CLAY DRAIN TILE—Prices are delivered per 1,000 lin.ft.:

Size, In.	New York	Birmingham	St. Louis	Dallas	San Francisco
3	$45.00	$45.00	$50.00	.....	.....
4	56.00	56.00	50.00	$73.00	$67.50
5	.....	80.00	85.00	110.00	86.25
6	90.00	105.00	85.00	118.00	112.50
8	150.00	175.00	195.00	150.00	175.00

Miscellaneous

LINSEED OIL—Raw oil, f.o.b. in 1- to 4-bbl. lots, per lb.:
New York....$0.108 Chicago....$0.108 Minneapolis....$0.11

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b., New York: White, dry or in oil, $13.25; Red, dry, $13.25; Red, in oil, $14.75.

CHEMICALS—Water and sewage treatment chemicals, round lots in the New York market:

Sulphate of aluminum, iron free, in bags, per 100 lb	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb	5.30@ 5.50
Soda ash, 58%, in bags, per 100 lb	1.32@ 1.35
Chlorine, liquid, cylinders, per lb	.05½@ .08
Bleaching powder, in drums, f.o.b. works, per 100 lb	2.00@ 2.10

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ½-in., 8-ft.; ⅝-in., 6-ft.; ¾-in., 4½-ft.; 1-in., 3½-ft.; 1¼-in., 2-ft., 10-in.; 1½ in., 2-ft. 4 in. Following are prices per pound for ½-in. and larger delivered in 1,200-ft. coils:

Atlanta	$0.25	Kansas City	$0.26
Baltimore	.22½	Los Angeles	.25
Birmingham	.35@.40	Minneapolis	.22
Boston	.25	Montreal	.24½
Chicago	.20	New Orleans	.23½
Cincinnati	.21	New York	.24
Cleveland	.30	Philadelphia	.24
Dallas	.20	San Francisco	.20½
Denver	.23	Seattle	.21½
Detroit	.24½	St. Louis	.19½

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carloads:

Tar felt, per 100 lb	$3.27½
Asphalt felt, per 100 lb	3.50
Asphalt coating, per gal	.40
Tar pitch, in 350 lb. barrels, per ton	31.00

PREPARED ROOFINGS—Prices to contractors, in carloads, f.o.b., New York per square:

Single shingles, slate finish, sufficient to cover 100 sq.ft.	$6.12½
Strip shingles, 4 in 1, hexagonal shape, with Underwriters' label	5.00
Slate surfaced roofing in rolls weighing 85 to 90 lbs.	2.50

WINDOW GLASS—United inches 25, bracket size 6x8 to 10x15, single or double thickness, discount from jobbers' list (Mar. 1, 1913), at New York warehouses:
AA .....83% A .....88% B.....89%

EXPLOSIVES—Prices per pound for dynamite delivered in small lots:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.22	$0.245	Los Angeles, f.o.b.†	$0.1875	$0.2225
Baltimore	.215	.2375	Minneapolis	.1967	.2173
Birmingham, f.o.b.	.155	.185	Montreal	.195	.22
Boston	.25	.275	New Orleans	.235	.26
Chicago	.195*	.22*	New York	.26‡	.2825‡
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	.24	.29	St. Louis	.215	.24
Denver, f.o.b.	.1925	.215	San Francisco	.1625	.1925
Kansas City, Mo.	.2025	.2225	Seattle	.16	.185

*Quantities above 500 lb. but less than a ton. †San Fernando Arsenal. ‡Special gelatin in case lots.

Lumber

Prices Are Per Thousand Feet, Board Measure

San Francisco—Prices of rough Douglas fir, No. 1 common, at yards; prices delivered to contractor at site of job, $1.50 to $5 per M. ft. additional:

	10-16-18 and 20 Ft. No. 1 Douglas Fir	22 and 24 Ft. No. 1 Douglas Fir
3x3 and 4	$28.00	$29.00
3x6 and 8	28.00	29.00
3x10 and 12	28.00	29.00
3x14	31.00	33.00

Chicago—Prices, f.o.b., in carloads, per M. ft. b.m.; prices delivered to job in truckloads from stock, $10 per M. ft. additional:

	20 Ft. and Under No. 1 Long-Leaf Yellow Pine	Up to 32 Ft. No. 1 Douglas Fir
3x4 to 8x8	$37.50	$42.00
3x10 to 10x10	46.50	42.00
3x12 to 12x12	56.50	42.00
3x14 to 14x14	.....	43.00

New York—Prices per M. ft., b.m., wholesale, for rough, long-leaf, yellow-pine timbers in quantities of 35,000 ft. or more, within lighterage limits:

	20 Ft. and Under Long-Leaf Yellow Pine	22-24 Ft. Long-Leaf Yellow Pine
3x4 to 8x8	$41.00@$43.00	$42.00@$44.00
3x10 to 10x10	48.00@ 50.00	49.00@ 51.00
3x12 to 12x12	55.00@ 57.00	56.00@ 58.00
3x14 to 14x14	63.00@ 65.00	64.00@ 66.00

Other Cities—Prices delivered per M.ft., b.m.:

	8x8-In. x 20 Ft. and Under, Rough				3x12 to 12x12-In. 20 Ft. and Under, Rough	
	Pine*	Fir†	Hemlock	Spruce	Pine*	Fir†
Atlanta	$45.00	.....	.....	.....	$65.00	.....
Baltimore	36.00	$50.25	$54.00	$61.50	75.00	$50.50
Birmingham	35.00	.....	.....	.....	40.00	.....
Boston	48.00	47.00	*47.25*	50.00	*56.00*	50.00
Cincinnati	36.00	49.00	47.00	47.00	40.00	53.00
Dallas	57.50	57.50	.....	.....	57.50	57.50
Denver	.....	*32.25*	.....	.....	57.00	*33.25*
Detroit	65.00	55.00	.....	.....	65.00	54.50
Kansas City, Mo.	40.50	38.75	.....	.....	53.50	48.75
Los Angeles	.....	44.00	.....	.....	.....	44.00
Minneapolis	54.00	49.25	36.25‡	.....	$54@56	49.25@50.75
Montreal	50.00	55.00	.....	.....	49.00	48.00
New Orleans	50.00	.....	.....	.....	67.00	.....
Philadelphia	*52.00*	*35.00*	*42.00*	*40.00*	*65.00*	*35.00*
St. Louis	45.00	39.00	.....	.....	53.50	39.50
Seattle	.....	23.00	.....	.....	.....	22.50

	1x10 In. x 16 Ft. and Under, Rough			2x10 In. x 16 Ft T. & Gr.	
	Pine*	Fir†	Hemlock	Pine*	Fir†
Atlanta	$60.00	.....	.....	$47.50	.....
Baltimore	56.00	$45.00	$45.00	35.00	$48.00
Birmingham	36.00	.....	.....	48.00	.....
Boston	44.00	42.75	*43.50*	48.50	47.50
Cincinnati	30.00	35.00	33.00	31.00	48.00
Dallas	.....	.....	.....	57.50	.....
Denver	.....	45.00	31.25	.....	45.00
Detroit	40.00	.....	.....	38.00	.....
Kansas City, Mo.	59.00	44.25	.....	42.75	36.75
Los Angeles	.....	38.00	.....	.....	57.00
Minneapolis	49.00	43.00	38.75‡	49.00	44.00
Montreal	45.00	48.00	40.00	85.00	70.00
New Orleans	36.00	.....	.....	48.00	50.00
Philadelphia	55.00	*36.50*	*36.00*	*52.00*	*36.50*
St. Louis	*39.00*	.....	.....	*29.50*	.....
Seattle	.....	22.50	.....	.....	23.00

*Long-leaf yellow pine. †Douglas fir. ‡F.ob.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34½
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41